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PETTEY (F. W.). **Control of Cochineal in Spineless Cactus Plantations. Revised Measures.**—*Fmg. in S. Afr.* 1946 repr. no. 60, 5 pp. Pretoria, 1946.

In this revision of a paper already noticed [*R.A.E.*, A **32** 163], the author states that of the insects introduced into South Africa for the control of prickly-pear [*Opuntia*], *Cactoblastis cactorum*, Berg [*cf.* **36** 171] is now so much attacked by ants, parasites and disease organisms that it does little more than maintain itself on prickly-pear and causes only slight damage to the spineless species of *Opuntia* that are used as fodder crops.

Dactylopius opuntiae, Ckll., has proved successful against prickly-pear in inland areas, but has spread to almost all the plantations of spineless cactus in Cape Province, has appeared in widely separated areas throughout the Union, and is likely to cause considerable damage. Neglected, isolated prickly-pear plants, or clusters of prickly-pear in spineless-cactus plantations in the northern Cape Province, Orange Free State and the Transvaal facilitate its spread; aided by a few prickly-pear or spineless-cactus plants in gardens, it has spread to spineless-cactus plantations throughout the Karoo, many miles distant from the prickly-pear on which it was liberated.

The bionomics of *D. opuntiae* are described; it increases most rapidly in the summer months and in seasons of prolonged drought, and at Uitenhage there is one generation every two months in summer and about every three months in winter. Spineless-cactus plantations should be inspected regularly, and if only a few leaf-pads or parts of plants are infested, the insect clusters can be crushed with the fingers. Grazing stock in plantations should be avoided, because the numerous stumps of partly eaten leaf-pads make the detection and destruction of the insects difficult. If a few scattered plants are heavily infested, these should be burned by means of straw or dried grass piled round and over them. If infestation has been allowed to become extensive, or if grazing of stock is essential, biological control may be attempted. The Coccinellids, *Cryptolaemus* [*montrouzieri*, Muls.] and *Exochomus* [*melanocephalus*, Zoubkoff] which are predacious on it [*cf.* **30** 563], are now widely distributed throughout the prickly-pear areas and are most numerous from early September to November. They should be collected from prickly-pear and liberated in the plantations from about August to October, several hundred on each heavily infested plant. As many of the beetles die in summer and most of them fly away when *Dactylopius* becomes scarce, supplies should be replenished annually or whenever *Dactylopius* becomes abundant after a period of scarcity. In view of the large numbers of beetles required, commercial control cannot usually be achieved by this means, particularly in the Karoo.

In these circumstances, the establishment of new plantations of spineless cactus is for the present inadvisable and the use of a substitute drought-resistant forage plant such as American aloe [*Agave americana*] or saltbush should be considered. *Opuntia monterey*, which is almost spineless and is much grown on the Karoo, is not seriously attacked by *Dactylopius*, but comparative trials at Grootfontein have shown it to be one of the lowest yielding varieties and the least palatable, so that its cultivation has not been encouraged.

ALIBERT (H.). **Note sur un nouvel insecte vivant sur goyavier en Côte d'Ivoire.**—*Agron. trop.* **2** no. 1–2 pp. 69–71, 3 figs., 2 refs. Nogent-sur-Marne, 1947.

Descriptions are given of all stages of *Desmeocraera varia*, Janse, a Notodontid that was observed on guava in an experimental garden at Bingerville, Ivory Coast. It had previously been recorded only from Natal and the Transvaal, on *Mimusops obovata* and *M. discolor*. On guava, the eggs were laid in clusters of 60–80 on the undersides of the leaves during the first half of October. The larvae hatched in 10–12 days and fed in groups on the parenchyma of the

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leaves until after the second moult, when they scattered over the foliage. In the rearing experiments, many died between the second and fourth moult, apparently from a bacterial disease. Full-fed larvae pupated in light earthen cocoons in the soil ; the pupal stage lasted 11–12 days, and the adults lived for about a week. The moths were active chiefly at night, and remained concealed under the leaves during the heat of the day. About 50 per cent. of the larvae that were about to pupate were parasitised by the Phorid, *Megaselia scalaris*, Lw., the adult and pupa of which are described. The eggs of the parasite were inserted into the thorax of the fully fed larvae of the host and gave rise to larvae that fed in the host pupae for a few days and pupated in or on the soil.

LEVER (R. J. A. W.). **Annual Report of Entomologist for 1945.**—*Agric. J. Fiji* **17** no. 2 pp. 42–43. Suva, 1946.

The most injurious crop pests observed in Fiji in 1945 were *Cirphis unipuncta*, Haw., and *Marasmia venilialis*, Wlk., on rice [*cf. R.A.E.*, A **36** 267], *Graeffea crouani*, Le Guillou, on coconut, and *Crocidolomia binotalis*, Zell., on cabbage ; those of less importance comprise *Euscepes postfasciatus*, Fairm., and *Cylas formicarius*, F., on the tubers of sweet potato, *Adoretus versutus*, Har., on rose and egg-plant [*Solanum melongena*], *Anomocaulus fulvovestitus*, Fairm., on *Pandanus*, and *Agonoxena argaula*, Meyr., on coconut. The fruit-fly parasite, *Syntomosphyrum* (*Melittobia*) *indicum*, Silv., and *Liothrips urichi*, Karny, which attacks the weed, Koster's curse [*Clidemia hirta*], were sent to Naitamba Island in the Lau group [*cf.* **35** 43].

Crop pests collected during a visit to the New Hebrides and Solomon Islands included *Brontispa longissima*, Gestro, on coconut, and *Aulacophora similis*, Ol., on cucurbits [*cf.* **36** 267], which were important in both groups in July and August. Other pests in the Solomons were a species of *Sesamia* closely allied to *S. inferens*, Wlk., which injured rice on Guadalcanal, *Papuana huebneri*, Fairm., and *Compsolacon gracilis*, Cand., which attacked groundnuts, and *Amblypelta cocophaga*, China, which damaged cassava [*Manihot utilissima*] on Malaita. *P. huebneri*, which was accidentally introduced into Tarawa, in the Gilbert Islands [*cf.* **27** 366], now occurs throughout the Ellice Group on taro (*Colocasia*) and babai (*Alocasia*).

SALT (R. W.). **Moisture Relationships of the Wheat Stem Sawfly** (*Cephus cinctus* **Nort.). I. Some Effects of Desiccation.**—*Sci. Agric.* **26** no. 12 pp. 622–630, 1 graph, 2 refs. Ottawa, 1946. **II. Some Effects of contact Moisture.**—*T.c.* pp. 631–639, 2 graphs, 1 ref.

In Canada, *Cephus cinctus*, Nort., spends about ten months of the year in wheat stubs. The larvae are in diapause in the autumn, but the diapause is eliminated during autumn and winter, and transformation to prepupae, pupae and adults, all within the stubs, occurs in spring. The larvae normally react to temperature changes at the soil surface by moving up and down within the stubs, and some control is given by shallow tillage [*cf. R.A.E.*, A **29** 112], which deposits the stubble on the soil surface and exposes it more to desiccation and high temperatures. The laboratory investigations described in these two papers were made to determine at what stage and at what date the larvae are most susceptible to these conditions and, since the stubs and larvae may be wetted by rain, whether the larvae can recover on contact with moisture from almost lethal desiccation. The following is based almost entirely on the author's summaries. At temperatures of 86, 95 and 104°F. and relative humidities of 0 to 50, 0 to 60, and 0 to 80 per cent., respectively, naked larvae lost weight very rapidly at first and then more slowly, but did not die until their original weight had decreased by more than 40 per cent. They lost weight faster and

died sooner as the relative humidity decreased and as the temperature increased. Death occurred only as a result of desiccation ; exposure to temperatures up to 104°F. and removal from the cocoons and wheat stubs were not lethal in themselves. During desiccation, the amount of dry matter in the larvae was reduced, but the percentage of dry matter increased. Insects in stubs collected at frequent intervals between 30th April and 22nd June 1943, and 10th August 1943 and 15th June 1944, and exposed to standard drying conditions, showed considerable differences in resistance to desiccation during the period (mid-August till mid-June) normally spent in the stub. The larval stage showed considerable and irregular variation, but prepupae were less resistant and there was a further steady decrease in resistance as development proceeded to the adult stage. Dead insects showed the same general trends as living ones in rate of desiccation.

The moisture content of diapausing larvae in stubs that were submerged in tap water for one minute and then drained and kept in a closed glass jar for four days increased from 51·3 to 55·3 per cent. ; on exposure to a temperature of 104°F. and a relative humidity of 0 per cent., it fell to 51·7 per cent. in one day, but eleven days were required for mortality to reach 92 per cent., whereas among other larvae that had not been submerged it was complete in only four. The moisture content of larvae in stubs kept in moist soil for 17–35 days increased by 7–8 per cent. Other experiments also showed that the diapausing larvae readily absorb contact moisture at room temperature, often in large amounts. Small larvae were erratic and in many cases extreme in their absorption of contact moisture ; large and average-sized larvae reacted more moderately. In all the experimental larvae there was a slight decrease in dry weight, owing to physical activity and metabolism, but the increase in moisture content was considerably greater and caused a marked increase in total weight. Most of the larvae were already rather severely desiccated at the beginning of these experiments, and the changes observed can be considered as maxima.

WISHART (G.). **Observations on the Emergence of** *Macrocentrus gifuensis* **Ashm. (Hymenoptera, Braconidae).**—*Canad. Ent.* **78** no. 9–10 pp. 162–168, 2 graphs, 2 refs. Guelph, Ont. [1947.]

During laboratory rearing of *Macrocentrus gifuensis*, Ashm., a polyembryonic Braconid that was introduced into Canada for the control of *Pyrausta nubilalis*, Hb., it was found that all the adults from a single mass of cocoons emerged within 15 minutes, although those from different masses of identical age emerged over a period of about four days [*cf. R.A.E.*, A **36** 78]. Attempts were made to determine the factors involved in producing the rapid emergence of all the individuals from a single mass of cocoons and the stimuli necessary to produce the emergence of the first individual from a mass. The adults usually emerged during the early morning, and keeping the cocoons in a darkened box until 9 a.m. (in early March) retarded but did not eliminate normal emergence. It appeared, therefore, that although the increase of light at dawn is a factor involved in the onset of emergence, there is an innate rhythm in the species, and that if adults do not emerge between 6 and 9.30 a.m. they are unlikely to do so until the following morning. Observations at 15-minute intervals from dawn onwards showed that when the cocoons were separated and isolated, emergence was spread over about four days, as in different masses of identical age, indicating that the simultaneous emergence of all individuals from a single mass of cocoons is stimulated by the first emergence. When cocoon masses were divided into approximately equal parts, each half showed the same rapid emergence as an individual mass, but the times of emergence from the corresponding halves differed, 24 hours elapsing between emergence from the two parts in some cases. Masses divided into three showed the same effect. To

determine whether the stimulus provided by the emergence of the first adult was mechanical, cocoon masses were halved and one set of halves placed on trays that were shaken by hand or vibrated rather violently for ten minutes out of every hour by an electrical device. It was found that 24 half-masses on trays shaken by hand and 12 on those shaken electrically gave emergence before the corresponding unshaken halves and only four and one, respectively, after them.

It is concluded that the time of emergence is influenced by developmental factors, which act during the immature stages of the insect to determine the duration of development, and immediate factors, which stimulate the mature adult within the cocoon to perform the final act of emergence, such as the normal daily fluctuation of light and dark and the presence of mechanical stimulation at the time during which emergence might be expected. The movements of the first emergent within its cocoon may be transmitted through the cocoon mass, or its movements while walking over the cocoon mass may initiate further emergence. It is evident, however, that as the individuals in each mass are of identical age and have been subject to the same developmental factors, all are in a highly sensitive state, so that comparatively slight stimuli suffice to cause emergence.

NEARY (M. E.). **The Insect Outlook for 1947.**—*83rd Rep. N. S. Fruit Gr. Ass. 1946* pp. 22–25. Kentville, N.S., 1946.

Notes are given on the prevalence of insects that were injurious in orchards in Nova Scotia in 1946; the most important on apple was the eye-spotted budmoth [*Spilonota ocellana*, Schiff.], which was widespread and prevalent in the majority of orchards and was expected to be an important pest throughout the fruit-growing districts in 1947. Other insects that were expected to be injurious to apple in that year were the codling moth [*Cydia pomonella*, L.] which injured less fruit in 1946 than in 1945; the grey-banded leaf roller [*Eulia mariana*, Feld.] which was equally abundant in the two years; the rosy apple aphis [*Anuraphis roseus*, Baker], which was moderately prevalent in 1946; and the green apple bug [*Neolygus communis novascotiensis*, Knight] and the apple red bug [*Lygidea mendax*, Reut.], both of which increased in numbers in 1946 and were injurious in many orchards.

PICKETT (A. D.). **A progress Report on long term Spray Program.**—*83rd Rep. N.S. Fruit Gr. Ass. 1946* pp. 27–31. Kentville, N.S., 1946.

The author discusses the results obtained in 1944–46 in experiments in Nova Scotia on the long-term effects of spray chemicals on injurious and beneficial insects and mites in apple orchards [*cf. R.A.E.*, A **36** 270], with reference to the effect of fungicides on the oyster-shell scale [*Lepidosaphes ulmi*, L.] and the European red mite [*Paratetranychus pilosus*, C. & F.].

It was found that *L. ulmi* increased from year to year when a programme of mild sulphur sprays was applied, since these destroyed both the parasite [*Aphytis mytilaspidis*, LeB.] and the predacious mite [*Hemisarcoptes malus*, Shimer] that control it under natural conditions. Lime-sulphur sprays also destroyed these natural enemies, but since they killed considerable numbers of the scale as well, the latter would rarely become a serious pest if a regular lime-sulphur spray programme was carried out. Copper sprays and sprays of Fermate [ferric dimethyldithiocarbamate] allowed both natural enemies to thrive, and the latter will destroy the scales in 1–3 years, the time depending on the initial degree of infestation, after the adoption of these sprays in place of sulphur. Observations in commercially sprayed orchards confirmed these results.

Populations of *P. pilosus* appeared to be favoured by sulphur sprays, but decreased very considerably when copper was used. Fermate appeared to cause an increase in the mite populations by destroying the natural enemies, and since copper sprays are likely to cause fruit russeting if used near flowering time, it is not possible to recommend any sprays that will allow mite control through natural means. In most districts, summer oils or other acaricides are applied against *P. pilosus* as a standard practice. The clover mite [*Bryobia praetiosa*, Koch] was almost completely controlled by sulphur sprays ; neither it nor its natural enemies were affected by copper, so that it is unlikely to reach dangerous levels of population where copper sprays are used.

SCHECHTER (M. S.), HALLER (H. L.) & POGORELSKIN (M. A.). **Colorimetric Determination of DDT in Milk.**—*Agric. Chem.* **1** no. 6 pp. 27, 46, 20 refs. New York, N.Y., 1946.

The literature on the accumulation of DDT in the fatty tissues of animals that have ingested it, its occurrence in their milk, and the various methods of analysing and estimating it is reviewed. Many of the analytical methods, especially those dependent on the determination of chloride [*cf. R.A.E.*, A **33** 160], are neither specific nor sensitive enough to detect traces of DDT, especially in the presence of large amounts of fatty matter. The Schechter-Haller colorimetric method [**33** 368 ; **35** 412] is unsatisfactory when the amount of fat to be analysed exceeds a few decigrams, and the method here described, which is based on the solubility of fat and the insolubility of DDT in concentrated sulphuric acid, was therefore devised to reduce the fat to a small residue containing the DDT ; this residue can be satisfactorily analysed by the Schechter-Haller method. Preliminary analyses by this procedure showed that milk may contain up to 25 or more parts DDT per million, according to the amount consumed by the cow. It is evidently concentrated in the butter fat, since the DDT content of butter made from milk containing 25 p.p.m. was as high as 532 p.p.m. [*cf.* **36** 379]. Fat from a T-bone steak contained 178 p.p.m., whereas the carefully trimmed lean meat from the same steak contained only 4.

WILSON (H. F.) & JACKSON (M. L.). **Electrostatic Effects produced in Dust Clouds.**—*Agric. Chem.* **1** no. 6 pp. 32–33, 35, 49–50, 61–62, 2 figs., 4 refs. New York, N.Y., 1946.

The following is largely the authors' summary. A mechanism involving electrostatic induction of a charge on the plant [*R.A.E.*, A **33** 277] is postulated to explain the way in which the electrostatic charge on the dust particles of insecticidal dusts [**29** 569 ; **30** 604 ; **33** 277] influences their distribution and adherence to plants and insects. To obtain further information on the charge of insecticidal dusts, a study was made of a wide variety of materials that are included in them. It appeared that electrostatic properties are controlled by two general sets of factors. These are the mineralogical characteristics such as hardness, type of cleavage, ease of fracture and type of crystal habit (whether fibrous, prismatic, etc.), which affect the particle-size distribution, and the chemical constitution and lattice structural arrangements, which determine the acid or alkaline reaction. Charge development was reduced or prevented when the particles were too large to pass through a 60-mesh sieve or were less than 2μ in diameter [*cf.* **35** 392]. Within the favourable size range, negative electrostatic charges were found with acidic materials, and notably among the silicates with quartz, talc, and pyrophyllite, which on cleavage or fracture expose silica tetrahedral structures. Positive electrostatic charges were found

with alkaline materials or those silicates that on cleavage or fracture yield alkaline cations or hydroxyl lattice structural groups at surfaces. This relationship may be viewed as a loss of protons from acidic and loss of hydroxyl ions from alkaline surfaces. The electrostatic charges found with the various minerals agreed well with that expected from these generalisations coupled with a knowledge of their crystal lattice constituents, arrangements and cleavage characteristics.

It is believed that information on the electrostatic behaviour of minerals will aid in proper selection of effective materials for use in insecticidal dusts, and place the selection on a less empirical basis.

UNDERHILL (G. W.). **Insecticide Tests for the Garden Fleahopper.**—*Tech. Bull. Va agric. Exp. Sta.* no. 101, 22 pp., 25 figs. Blacksburg, Va., 1946.

The garden fleahopper [*Halticus bracteatus*, Say] has caused serious and widespread injury to clover and lucerne in Virginia for several seasons and has also injured garden crops, such as beans and tomatos. Several proprietary insecticides were tested against adults and nymphs on beans or quickweed in cages in the laboratory in 1944 and 1945, and some of them were also tested on clover in the field in 1945.

In cage tests, dusts containing 0·2, 0·4, 0·8, 1 and 2 per cent. DDT were very effective, the first two giving complete kill within 72 hours; the 1 per cent. dust applied to débris under the plants or to the floor only gave 80 and 60 per cent. kill, respectively, in five days. Sprays containing 4 and 8 oz. actual DDT (as a wettable powder) per 100 U.S. gals. water gave a very satisfactory kill when applied to both surfaces of the leaves, and satisfactory but slow control (almost complete kill in 96 hours) when applied to the upper surfaces only. In the field, single applications of dusts containing 0·5, 0·8 and 1 per cent. DDT or of sprays containing 4 or 8 oz. DDT per 100 U.S. gals. water gave good control for 5–7 weeks, and two applications several weeks apart controlled the fleahoppers for the entire season.

In the laboratory, a spray of 10 lb. sulphur per 100 U.S. gals. water gave less than 50 per cent. mortality in 144 hours, and in the field, two applications of sulphur dust at the rate of 100 lb. per acre did not give very effective control, though they caused a distinct reduction in the number of fleahoppers. Dusts of Lethane B–71, a dry concentrate of β, β′-dithiocyanodiethyl ether, in talc or sulphur gave a rapid knockdown in the laboratory; 1 and 2 per cent. dusts killed all the bugs in 18–24 and 3–6 hours, respectively, but 0·15 and 0·3 per cent. dusts lost their effectiveness after 18–24 hours, before complete kill was obtained. In limited tests, dusts of Lethane B–72 (Lethane B-71 with the addition of a wetting agent) in sulphur or talc gave somewhat similar results. In field tests, a spray of 2½ lb. Lethane B-72 per 100 U.S. gals. water and dusts of 0·15–2 per cent. Lethane B-71 in talc were toxic when first applied, but soon lost their effectiveness. A spray of 1¼ lb. C-336 (DN-111), a preparation containing 20 per cent. of a dicyclohexylamine salt of dinitro-o-cyclohexylphenol, per 100 U.S. gals. water showed little toxicity in laboratory tests, but undiluted dusts of C-401 (DN-5), containing 1 per cent. dinitro-o-cyclohexylphenol and 50 per cent. sulphur, and of C-412, which is the same with the addition of 0·025 per cent. pyrethrins, killed nearly all the bugs within 1–2 hours. In the field, C-401 gave good control for three weeks, but the population in the dusted plot was almost equal to that in the untreated plot after 5–6 weeks.

Dusts of P-C-H (5 per cent. piperonyl cyclohexanone), diluted to contain 1 or 2 per cent. active ingredient, gave variable results in the laboratory, but total kills of 70 and 80 per cent., respectively, were obtained in 96 hours. The addition of 0·9 per cent. rotenone to 1 per cent. P-C-H increased the kill,

although the results were still variable, and the addition of 0·2 per cent. pyrethrins caused a much quicker and more definite kill, the results comparing favourably with those from DDT or Lethane. In field tests, P-C-H dusts gave poor kills. Black Leaf 10 Dust Base, containing 10 per cent. free nicotine, when diluted with hydrated lime to contain 1 and 2 per cent. nicotine, gave only about 30 and 60 per cent. mortality, respectively, in cages, even when these were kept covered for 1–5 minutes after treatment, and the survivors seemed to be normal. A dust of one-year-old cubé powder diluted with talc to contain 2 per cent. rotenone gave a good kill, though knockdown was slow, but a similar dust containing 1 per cent. rotenone and one of Agicide (0·12 per cent. rotenone and 0·32 per cent. other active ingredients) were ineffective. A mixture of cryolite and sulphur (1 : 9) killed only 50 per cent. of the fleahoppers in four days, and unsatisfactory results were also obtained with a mixture of equal quantities of cryolite, sulphur and talc. In preliminary laboratory tests, the bugs were knocked down immediately by 5, 10 and 20 per cent. sabadilla dust and no revival was observed. In cage tests with mixed dusts, DDT and rotenone in dusts containing either 0·5 or 1 per cent. of each gave about 80 per cent. kill in 24 hours and 90 per cent. in 48 hours in the laboratory ; a mixture of Black Leaf 155 with DDT, containing 1 per cent. fixed nicotine and 2·4 per cent. DDT, gave about the same kill after 48 hours, though it was slow in action ; the addition of Lethane B-71 to DDT hastened mortality, but did not increase the total kill over that obtained with DDT alone ; and the total kill obtained with a dust containing 1 per cent. rotenone and 0·3 per cent. Lethane B–71 was only 80 per cent.

Parker (W. L.) & Beacher (J. G.). **Toxaphene, a chlorinated Hydrocarbon with insecticidal Properties.**—*Bull. Del. agric. Exp. Sta.* no. 264, 27 pp., 4 figs., 6 refs. Newark, Del., 1947.

Some of the information in this paper on the properties of Toxaphene, a chlorinated camphene with the approximate empirical formula $C_{10}H_{10}Cl_8$, has already been noticed [*R.A.E.*, A **36** 224]. Like DDT, it has one labile chlorine atom, and should not be used with strongly alkaline materials. Technical Toxaphene is a waxy solid that contains 67–69 per cent. chlorine, melts in the range of 65–90°C. and is highly soluble in common organic solvents. The solid can be stored in cardboard cartons or paper bags and solutions in suitable cans for at least a year without deterioration. Corrosion studies were made with Toxaphene mixtures and commonly used container materials. Test strips of aluminium, tin plate, Terne Plate, stainless steel, galvanised iron, black iron, and black iron coated with cellulose acetate lacquer or with Four A Lacquer (Interchemical Corporation) were half submerged in a 25 per cent. oil-soluble concentrate of Toxaphene, a 5 per cent. solution of this concentrate in deodorised kerosene and in a 50 per cent. water-miscible concentrate. Observations over a period of five months showed that if the oil-soluble concentrate contained no water or one drop per 10 ml., containers of aluminium, stainless steel, galvanised iron and black iron coated with Four A Lacquer would be satisfactory, while if it contained no water, tin plate could also be used. None of the materials tested showed evidence of corrosion when exposed to the kerosene solution unless moisture was present, when only aluminium, stainless steel and black iron coated with Four A Lacquer were satisfactory. The last was the only material tested that proved suitable for the water-miscible concentrate, when water was present ; when it was not, tin plate and galvanised iron also appeared satisfactory.

In the course of tests against various insects [*cf.* A **36** 225 ; B **36** 199], pieces of woollen cloth treated with 0·8 or 1·25 per cent. of their weight of Toxaphene and exposed to attack by larvae of *Attagenus piceus*, Ol., *Anthrenus*

vorax, Waterh., or *Tineola biselliella*, Humm., for two weeks at 80°F. and 50–60 per cent. relative humidity were not injured, and little or no loss in efficiency was observed when the same cloth was exposed to *Attagenus* a year later or when it was subjected to severe abrasion before exposure. Dry-cleaning fluids removed Toxaphene from the cloth by simple solvent extraction, but washing with soap, washing soda and water at 105°F. caused only a slight decrease in effectiveness.

Tests on 200 human subjects showed that Toxaphene is neither a skin irritant nor a skin sensitiser, and acute toxicity studies on white rats indicated that it is considerably less toxic in deodorised kerosene than in maize oil. The maximum dose that killed none of ten or more rats, the dose that gave 50 per cent. mortality, and the smallest dose that gave complete mortality were 73, 120 and 145 mg. per kg. body-weight for Toxaphene and 70, 115 and 230 mg. per kg. for DDT, both in maize oil, and the corresponding doses of Toxaphene in maize oil for dogs were 10, 20–30 and 50 mg. per kg. Toxaphene appeared to kill dogs by stimulation of the central nervous system, and treatment with sodium pentobarbital, a depressant of the central nervous system, prevented the death of five of six animals that received 60 mg. Toxaphene per kg.

CLANCY (D. W.). **The Insect Parasites of the Chrysopidae (Neuroptera).**—*Univ. Calif. Publ. Ent.* **7** no. 13 pp. [3]+403–496, 40 figs., 6 pp. refs. Berkeley, Calif., 1946.

The author records 13 Hymenoptera belonging to 12 genera in eight families and two Clerids of the genus *Hydnocera* that were reared from two species of *Chrysopa* found in southern California. He gives short accounts of the biology of most of the parasites, including the Clerids, and describes some of the stages. The degree of parasitism was dependent mainly on the host density; it was frequently very high, but seemed to have relatively little effect on the average density of *Chrysopa* populations.

A tabulated list of all the known parasites of Chrysopids is appended, showing hosts and localities and the authorities for the records.

ARMITAGE (H. M.) & others. **Bureau of Entomology and Plant Quarantine.**—*Bull. Dep. Agric. Calif.* **35** no. 4 pp. 185–229, 1 map. Sacramento, Calif. [1947.]

Epilachna varivestis, Muls., which had not previously been recorded west of the Rocky Mountains, was found on lima beans in Ventura County, California, in July 1946. An intensive survey showed that almost 2,000 acres were infested, practically in the centre of 44,000 acres of beans representing one of the most productive areas in the State. The crop on one property of 25 acres, which was the most heavily infested and apparently the focus of the infestation, was destroyed by burning and repeated disking. All the other infestations were within six miles of this, with the spread more pronounced to the north and east in the direction of the prevailing winds, and these were dusted at intervals of two weeks, first with 0·5 per cent. rotenone, then with 50 per cent. cryolite and finally with cryolite and a thiocyanate (Lethane) applied from aircraft, with ground machines or by hand at rates of 30–50 lb. dust per acre. The results were not wholly satisfactory, as it was difficult to cover the undersides of the leaves of the plants, which were mature, but a minimum of reproduction was observed after treatment, and the numbers of beetles entering hibernation were much reduced. All beans, bean straw and harvesting equipment moving out of the area was fumigated. It was found that methyl bromide could be safely and effectively used on green or dry beans under a gas-tight tarpaulin

or in a gas-tight chamber at the rate of 3 lb. per 1,000 cu. ft. for two hours at 70°F. [*sic* ? 80°F.], 3½ lb. at 70°F. or 4 lb. at 60°F. Where the cost of materials was more important than the time taken, a dosage of 1 lb. per 1,000 cu. ft. for 24 hours at temperatures of 60°F. or more or of 2 lb. for 12 hours was approved for dry beans, and where time was more important or gas-tight tarpaulins of sufficient size were not available for covering large units of harvesting equipment, fumigation with 2 oz. sodium cyanide or its equivalent (40 cc. liquid HCN) per 100 cu. ft. for one hour under canvas at temperatures of 50°F. or more was authorised. An extensive survey in neighbouring counties revealed no infestation.

The results of surveys of the distribution of the grape leaf skeletoniser, *Harrisina brillians*, B. & McD. [*cf. R.A.E.*, A **36** 190] and of wild grape are given. Attempts to eliminate this food-plant were begun on 1st May, to the north and east of Ramona to prevent natural spread to cultivated grapes in the San Pasqual Valley and the Escondido district, and in the area between the Barrett Reservoir and Potrero to prevent spread into Lower California, which would seriously complicate the eradication programme [*cf.* **36** 185]. Heavy growth of wild grape in the San Diego River and San Vicente Valley was sprayed to decrease the population of moths flying towards Ramona and Witch Creek. Treatment of cultivated grapes within the control area was carried out against the different generations from 11th June until September. The first application of 50 per cent. cryolite at 30 lb. per acre was made to 1,433 acres and 36,941 individual vines in gardens, and the second to 889 acres and 26,390 garden plants in the more heavily infested area or where recurring infestation was observed. Good control was obtained with one application made before the larvae of the first generation reached maturity and in all instances in which two applications were made. The only fumigation treatment found to be completely effective against all stages of *H. brillians* was methyl bromide used under a gas-tight tarpaulin or in a gas-tight chamber at the rate of 3 lb. per 1,100 cu. ft. for two hours at 80°F., and this was approved for use in case of the movement of living grape vines, cuttings, stumpwood and used containers to meet quarantine requirements. Pupae survived at all other rates that the plants could tolerate. As there is no possibility of the pupae being carried in or with the fresh fruit, lower dosages are permitted for this.

Adults of *Cydia* (*Grapholitha*) *molesta*, Busck, were found in two areas near Denair, Stanislaus County, where the moth had not been taken since 1943; the seasonal survey revealed no other material extension of the infested area [*cf.* **36** 184]. There was no alarming increase in field infestation anywhere, and the heavier centres of infestation continued to be in Orange and Fresno Counties. Nearly 23 million parasites [*Macrocentrus ancylivorus*, Rohw.] were liberated in 13 counties in 1946 at an average rate of 10,000 per acre on all infested properties recorded.

Conditions favouring *Eutettix tenellus*, Baker, in the autumn of 1945 resulted in nearly epidemic populations in the south end of the San Joaquin Valley, and effective control was not obtained in several thousand acres, with the result that there was a serious outbreak, which spread into the Salinas Valley, in the summer of 1946. It did not extend into the Sacramento Valley, owing to effective spraying of the lighter populations overwintering in that area and because strong north winds during the period of spring flight kept most of the leafhoppers in the south of the valley, where there was an abnormal acreage of Russian thistle [*Salsola*] on open range land. Losses of canning tomatos were minimised in the northern valley counties by delaying planting until after the spring flight in mid-April. The outbreak would have been more serious in the southern valley counties and in the Salinas Valley if it had not been for early drying of spring breeding plants in some areas, which eliminated large

numbers of nymphs, local rains in other areas that resulted in the growth of Russian thistle and so kept the insects on range land, the use of seed of resistant varieties of sugar-beet in replanting several hundred acres killed by frost, and preventive measures in the cultivated areas. The application of 5 per cent. DDT dust to young plants of late tomatos and neighbouring Russian thistle and prompt application of DDT to weeds in beet fields when influxes of insects occurred gave effective protection. Spraying was carried out over 3,569 acres in the San Joaquin Valley, chiefly with pyrethrum and a thiocyanate in diesel oil [*cf.* **34** 374], though in large-scale tests on non-grazing land a spray of 1 lb. DDT per 5 U.S. gals. diesel oil per acre gave encouraging results. It was clear that spraying alone will not control the leafhopper in years of great abundance and that the elimination of Russian thistle was effective in preventing outbreaks. There were serious losses of tomato and melon due to curly-top virus [*Chlorogenus eutetticola* of Holmes], as a result of the feeding of a large leafhopper population, but they diminished rapidly from south to north.

A fairly heavy infestation by *Nilotaspis halli*, Green, a serious pest of almond, peach and apricot, was found on trees in gardens at Oroville, Butte County, the first recorded outside the original infested area since eradication began in 1941. The new infestation lies approximately 20 miles south and east of the nearest one previously recorded, and immediate surveys showed 282 infested trees. All these were immediately sprayed to check the scale until they could be fumigated [*cf.* **36** 185].

Adverse weather and a widespread use of poison baits in suspected areas almost eliminated attack by grasshoppers. In the south of the San Joaquin Valley and along its western side, the early spring was so dry that the rangeland cover grew little. Most of the first hoppers of *Oedaleonotus enigma*, Scud., were destroyed by a severe rainstorm shortly after a warm period had resulted in 75 per cent. hatch, but the storm was too short to benefit the range plants, and when the remaining hoppers of this species and those of *Melanoplus mexicanus devastator*, Scud., hatched, there was not sufficient food for their development. This caused an early migration, chiefly of second- and third-instar hoppers, which was easily intercepted with poison bait at the margins of cultivated fields.

A severe outbreak of *Phylloxera vitifoliae*, Fitch, occurred on the leaves of 12 grape vines of experimental root-resistant crosses near Fresno ; the foliage was extremely galled, with all stages present. All 12 vines were destroyed, and the surrounding soil was treated. This was the first record of the leaf form of *Phylloxera* in California.

Traps installed near airports and golf courses for *Popillia japonica*, Newm., and in pear orchards for *Psylla pyricola*, Först., caught no examples of these species. Examination of gin trash from the major Californian cotton-producing areas between 24th November and 15th December did not reveal the presence of the pink bollworm [*Platyedra gossypiella*, Saund.], the boll weevil [*Anthonomus grandis*, Boh.] or any other important cotton pest. As a result of the discovery of *Pantomorus leucoloma*, Boh., in certain nurseries in Georgia, plants from three consignments that had been sent to California as nursery stock in 1938 and one sent in 1946 were examined. Intensive search disclosed no trace of the beetle, but the plants were removed from the ground and replanted in new positions after the roots had been thoroughly washed, and all soil in the holes and surrounding them was treated with DDT at a concentration that would ensure complete mortality of any larvae that might have been present and escaped detection.

Winter surveys in the counties adjacent to the area in the San Joaquin Valley infested by *Parlatoria oleae*, Colv., disclosed infestations in San Joaquin County, and an infestation in Los Angeles County was found in mid-season. Intensive control measures were immediately applied to all new infestations,

and apparently eliminated the scale from 31 of the 36 properties under treatment. An extra light emulsive oil containing 4½ per cent. DDT, used at a concentration of 5 per cent., was found to kill 95 per cent. or more of the scales on various plants and trees of commercial importance. *Eulecanium* (*Lecanium*) *kunoense*, Kuw. [*cf.* **34** 374] was apparently restricted to the western half of Contra Costa and the eastern half of Alameda County, where it was rather general but most abundant in the Walnut Creek area and in the Moraga Valley. It attacked almond, apple, cherry, peach, pear, quince, plum and prune but showed a preference for the last two. One infestation was found on walnut and one on California buckeye [*Aesculus californica*]. There appeared to be little if any spread of *Pollinia pollini*, Costa, from or within areas into which it was apparently brought on imported stock from Italy [*cf.* **36** 187] ; infestation was limited to five plantings of olive on about 23 acres in San Diego and Sonoma Counties. *Hemiberlesia howardi*, Ckll., and *Diaspidiotus ancylus*, Putn., which prefer deciduous fruit trees, have recently attracted attention. They are so similar that they have been confused, and in the more heavily infested area they occur on the same plants. *H. howardi* appears to be the more injurious as it prefers the leaves, whereas *D. ancylus* prefers the twigs. Heavy infestations of one or the other have been observed on apricot since 1937, and surveys showed that *D. ancylus* was present in seven counties and attacked apple, apricot, plum, persimmon, walnut, pecan and *Hydrangea*, whereas *H. howardi* was found only in Riverside County and only on apricot, plum and peach, except for a single individual on olive. Both Coccids were found in practically every planting examined in the Hemet Valley in Riverside County, though infestations were generally rather light. Examination of mealybugs collected in various parts of California indicated that the species found in Lake County on pear and apple is either *Pseudococcus comstocki*, Kuw., or a species so closely allied that it cannot at present be separated from it, whereas the prevailing species on deciduous fruit trees in the Bay counties seems to be Baker's mealybug [*P. maritimus*, Ehrh.] or possibly an undescribed species. If the species in Lake County is *P. comstocki*, it is already too widely distributed to be eradicated.

Inspection of a walnut hulling plant in San Joaquin County indicated that it was not the source of heavy infestation by the codling moth [*Cydia pomonella*, L.] in a neighbouring peach orchard, as had been reported, since precautions were maintained at the hulling plant to destroy all larvae brought in with the walnuts. Reports that a grower of Kelsey plums had suffered severe loss from *C. pomonella* for three years were confirmed ; it had been expected that *C. molesta* would prove to be the species responsible. The walnut husk fly [*Rhagoletis suavis completa*, Cress.] attacked peaches at three places, one in Los Angeles County and two in Riverside County. Damage to cherry trees by *Scolytus rugulosus*, Ratz., was found to be due to its spread from piles of infested peach wood, and was reduced by the removal of the wood. Inspections in Sonoma and Santa Cruz Counties showed that more injury to the crowns of raspberry and Boysenberry was caused by the strawberry crown moth [*Aegeria bibionipennis*, Boisd.] than by the raspberry root borer [*Pennisetia marginata*, Harr.] ; although the latter occurred in wild blackberry in Santa Cruz County, it was not found in cultivated varieties during 1946. Before the war, losses of beans in a large area on the west of Stanislaus County were prevented by the destruction of annual sow thistle [*Sonchus oleraceus*] and prickly lettuce [*Lactuca scariola*], on which the bean thrips [*Hercothrips fasciatus*, Perg.] overwinters and spends the early spring [*cf.* **26** 129]. This work was discontinued during the war, but plans have been made to resume it, approximately 30,000 acres of beans being involved. Experiments against the European earwig [*Forficula auricularia*, L.], which is continually spreading in California, showed that three applications of 4–5 per cent. DDT dust at

intervals of two weeks gave good control of infestation about houses, barns and chicken yards. Effective control was reported with only two applications in Santa Barbara County, but not with one application in Los Angeles County.

Other pests recorded include a species of *Eriophyes* of uncertain identity [*cf.* **36** 82–83], which occurred very generally in apple buds, and in one case in Sacramento completely prevented a tree from fruiting; an Aphid, *Myzocallis kahawaluokalani*, Kirk., hitherto unreported from California, which was collected in October on crapemyrtle [*Lagerstroemia*] at Oroville; *Dynaspidiotus britannicus*, Newst., which was found to be established on *Buxus* in Berkeley and Oakland; and the oyster shell scale [*Lepidosaphes ulmi*, L.], which occurred on apple, on which it had not previously been recorded in California. Heavy infestations of the tulip-tree scale [*Toumeyella liriodendri*, Gmel.] were found on nursery trees of *Magnolia* sp. in San Joaquin and Los Angeles Counties [*cf.* **32** 114; **36** 189]. Nursery infestations of *Fatsia japonica* by *Pulvinaria* (*Protopulvinaria*) *pyriformis*, Ckll., and of *Liquidambar* by *Eriococcus borealis*, Ckll., were discovered and eradicated. The larvae of *Litoprosopus coachella*, Hill, which feed on the petioles of dead fronds of *Washingtonia* palms became troublesome in houses in two localities. This Noctuid is a native of southern and Lower California, but has followed the plantings of these palms up into the Sacramento Valley. When mature, the larvae drop from the palms, and if they enter a house in search of a place to spin a cocoon may chew parts out of clothing or cloth-covered furniture. The remedy is to remove the dead fronds from the palm trees. An unusual outbreak of *Aristotelia urbaurea*, Keif., occurred on blue oaks [*Quercus douglasii*] east of Marysville in September, when larvae of the second generation were defoliating the trees.

Investigation of repeated instances of serious injury to *Citrus* nursery stock fumigated with approved dosages of methyl bromide at atmospheric pressure in an approved chamber in southern California showed that it was due to the loose sandy nature of the soil in which the trees were balled, to the method of balling, which left surface rootlets exposed, and to the susceptibility of the varieties involved.

The report also includes sections dealing with the incidence of pests on various crops in different parts of the State and with pests intercepted at maritime ports, airfields and border inspection stations, and notes on changes in State Quarantine regulations.

McKenzie (H. L.). **Diaspid Scale Studies, with Notes on California Species (Homoptera ; Coccoidea ; Diaspididae).**—*Bull. Dep. Agric. Calif.* **36** no. 1 pp. 31–36, 2 figs. Sacramento, Calif., 1947.

The author reports the discovery of *Hemiberlesia howardi*, Ckll., on an olive fruit at Hemet, Riverside County, California in December 1944 and of mixed infestations of *H. howardi* and *Diaspidiotus ancylus*, Putn., on apricot and plum in the same area in October 1946 [*cf.* preceding abstract]. This is the first record of *H. howardi* in the State, for, although it had been collected by Federal workers on apricot several times since 1937, the information was apparently not published. Heavily infested twigs of current growth at Hemet were less than two inches long and mummified plum fruits were also infested with *H. howardi*; it is suspected that both species secrete toxic enzymes that result in twig stunting when infestation is heavy. It is not known which species causes the principal damage. Both were found on *Viburnum* sp., *H. howardi* on the leaves and *D. ancylus* on the stems.

Unaspis euonymi, Comst., was collected on *Euonymus* sp. at Stanford University in May, 1945, and at Palo Alto, Santa Clara County, and in Sacramento City in January 1947.

Characters separating the genus *Acutaspis* from *Melanaspis* are discussed, and two new species, *A. subnigra*, collected on the leaves of avocado in Peru in July 1945, and *A. tingi*, intercepted in quarantine on coconut from Mexico in May 1937, are described.

Thomas (H. E.) & Scott (E. E.). **Arsenical Injury, Leaf Spotting and Defoliation of Apple.**—*Bull. Dep. Agric. Calif.* **36** no. 1 pp. 37–38, 1 fig., 4 refs. Sacramento, Calif., 1947.

A spotting of apple leaves sometimes accompanied by considerable defoliation has caused concern for at least 15 years in the Pajaro Valley of Santa Cruz County, California, and has been attributed to several causes, including the frog-eye leaf spot fungus, *Sphaeropsis malorum*, well known in orchard areas in the Eastern United States. However, the authors know of only three definite reports of this fungus on apple in California in the last 30 years, and these concerned the bark rather than the leaves. Since 1935, several hundred cultures have been made from the leaf spots, in which the predominating fungus proved to be a species of *Stemphylium* closely resembling *S. congestum*. Inoculation tests in which this fungus from apple leaves was transferred to small potted apple plants resulted in slight to moderate infection in ten of 15 tests when the plants were subsequently kept for several days in a moist atmosphere, and particularly when the leaves were wounded, but no defoliation. It therefore appeared that fungi were not responsible for the leaf spot.

In 1945, when the application of standard lead arsenate at the rate of 4 lb. per 100 U.S. gals. water in an orchard of Yellow Newtowns was stopped by mechanical breakdown, it was observed in August that the sprayed trees had dropped many leaves and that the remaining leaves were heavily spotted, whereas adjacent unsprayed trees showed only an occasional spot and little or no defoliation. It therefore seems probable that the primary cause of the spotting and defoliation in this area is the arsenical spray and that the effect is aggravated by *Stemphylium*.

Loftin (U. C.). **Living with the Boll Weevil for fifty Years.**—*Rep. Smithson. Instn 1945* (Publ. 3827) pp. 273–291, 10 pls., 2 figs. Washington, D.C., 1946.

The author summarises the history of the spread of *Anthonomus grandis*, Boh., on cotton from Mexico to the United States, shows its present distribution in the cotton-growing regions there on a map and describes its life-history, the damage it causes and the methods of control attempted. Changes in the varieties grown, so that the crop matures early instead of throughout the season, and also in cultural methods, in order to hasten the maturing of the crop and permit early destruction of the cotton stalks, have reduced survival of the weevils from year to year. Control by insecticides, chiefly calcium-arsenate dusts applied from ground machines or aeroplanes, has also been developed, and recent trends in control, including chemical defoliation of the plants with calcium cyanamide, which hastens the opening of the large bolls, and the improvement of dusting equipment and attempts to find better insecticides, are discussed. The variations that occur in the losses caused by the weevil in different years and in different parts of the cotton-growing area and the factors responsible for them are also described.

Turner (N.). **Some fundamental Aspects of Control of the European Corn Borer.**—*Bull. Conn. agric. Exp. Sta.* no. 495, 43 pp., 16 figs., 15 refs. New Haven, Conn., 1945.

The author discusses the development of the use of insecticides for the control of the European corn borer [*Pyrausta nubilalis*, Hb.] on sweet maize in Connecticut [*cf. R.A.E.*, A **31** 508, etc.], and points out that control could be improved

by better methods of insecticidal treatment, by reducing the amount of infestation by cultural methods or by the development of less susceptible strains of maize. Dissection of plants after individual treatments in schedules of four applications at five-day intervals during the hatching period of a dual-fixed nicotine dust or a dust of nicotine fixed on bentonite (both containing 4 per cent. nicotine) failed to show that any one treatment had any special influence that could be measured at the end of the season. Cumulative frequency distribution curves for larval instars in ears, ear shoots and the other parts of untreated plants, obtained by dissecting plants at intervals of five days, showed no indication of the migration of larvae in the later instars to the ears, indicating that ear infestation is due to newly hatched larvae [*cf.* **31** 509]. Earlier in the development of the plant the young larvae were established in the developing tassel, and migrants from this settled mainly in the stalk. Three applications to the ears protected them less than four to the whole plant, however, even though the first of the four was applied before the ears were formed, possibly owing to a prolonged effect of the insecticide that collected in the axils of the leaves at the first treatment. The use of a hood that enabled the dust to be distributed over the entire plant resulted in more uniform control in different parts of the plant than direct application of the same amount of toxicant to tassels and ear shoots, though both reached about the same proportion of larvae ; but the latter treatment protected the tassels and ear shoots better, 1 per cent. fixed nicotine applied directly being as effective as 3–4 per cent. applied under the hood. Treatment of plants with and without tillers with the same amount of dust at the same concentration, applied first to the developing tassels and later to the ear shoots, killed about the same percentage of larvae on the plant. It is clear, therefore, that it is preferable to treat the main stalk rather than to scatter the insecticide over the entire plant, which indicates that migration takes place principally along the main stalk. Tests against the first generation in 1941 and 1942 and against the second in 1943 indicated that almost all the larvae killed were in the first instar.

With a few exceptions, commercial treatment of maize has not provided sufficient protection to eliminate sorting the harvested ears, possibly because the insecticides used were not toxic enough or the methods did not deposit the insecticide in the proper place. Attempts were therefore made to improve the performance of the insecticides in use and to find more toxic materials. When dusts were applied to the young tassels on 2nd August and to the developing ears on 7th, 12th and 17th August 1944, a fixed nicotine dust prepared from a commercial concentrate (Black Leaf 155) diluted with pyrophyllite appeared to be somewhat more effective than commercial dual-fixed nicotine in clay [*cf.* **34** 236]. Calculations made from the results of applying the dusts at various concentrations indicated that on the basis of larvae found after treatment, 0·5 per cent. DDT was equal to 0·7 per cent. rotenone as derris, 5 per cent. fixed nicotine or about 8 per cent dual-fixed nicotine, whereas on the basis of survival of larvae per egg-mass, 1 per cent. DDT was equal to about 0·4 per cent. rotenone, 4 per cent. fixed nicotine or 8 per cent. dual-fixed nicotine. Derris dust containing 1 per cent. rotenone was more effective than 4 per cent. fixed nicotine [*cf.* **32** 201]. In every case, the number of egg-masses that hatched was greater on treated than on untreated plants, particularly when DDT and derris were used. With these materials, there was a strong indication that more eggs hatched as the concentration of the rotenone or DDT increased, possibly because they destroyed predators that normally consume the egg-masses. In 1945, when dusts were applied to developing tassels on 6th August and to ear shoots on 10th, 15th and 20th August, Ryanex (a dust made from *Ryania speciosa*) was less effective when undiluted than when diluted to 50 per cent. with fibrous talc because of the poorer dusting qualities of the pure material, and 50 and 25 per cent. Ryanex were about as

effective as 1 and 0·5 per cent. DDT, respectively. In preliminary tests, 10 per cent. 761 (composition unknown), 4 per cent. Rhothane (dichlordiphenyldichlorethane), 4 per cent. methoxy DDT (dimethoxydiphenyltrichlorethane) and 5 per cent. CS431 (a chlorinated cyclic compound) were less effective than 4 per cent. DDT.

In tests in 1944 with genetic stocks of maize with abnormal tassels and ear growth, tassel abnormalities had little effect on the survival of larvae, because they hatched late owing to delay in oviposition caused by extreme drought, but the presence of normal ears was shown to be important in the establishment and survival of *P. nubilalis*, indicating that direct application of insecticides to the ears is necessary for proper protection. A comparison in 1945 of the effect of sparse and bushy tassels and of fertile and sterile pollen on survival of larvae failed to show any differences ; the tassels emerged relatively late in the oviposition period. A strain of maize that had shown little stem breakage after infestation had fewer eggs and fewer larvae than one that had shown much breakage, but the ratio of survival was higher on the former. The total numbers of eggs deposited and of larvae per plant increased and the numbers of eggs on and larvae in the main stems decreased as the number of tillers increased, and there was also a tendency for ear infestation to be smaller as the number of tillers increased.

Department of Agriculture (Kenya) Annual Report 1945.—[1-┌]125 pp. Nairobi, 1946.

The first part of this report, by D. L. Blunt, includes a section (pp. 15–17) on campaigns against *Schistocerca gregaria*, Forsk. An outbreak of the swarming phase of this locust began in East Africa in December 1942 and had not diminished by the end of 1945, but a series of hopper campaigns in Kenya and neighbouring territories, of which the first seven were carried out with the assistance of army personnel and transport, kept the swarm population at a low level in Kenya, and by September 1945 there were fewer swarms than at any time during the outbreak. In the campaign begun in late October 1944, which was the sixth in the series and involved an area of about 11,000 sq. miles, including southern Borana in Abyssinia, successful results were obtained by burning, beating and the use of poison baits of coffee husks [*cf. R.A.E.*, A **35** 306] or of cotton-seed husks. Few large swarms resulted from escapes in Kenya, but further swarms entered northern Turkana along the Omo valley and gave rise to large numbers of hoppers. In the next (long rains) campaign, which was on a much smaller scale, baits were again used and dinitro-ortho-cresol was tested on a field scale both as a spray suspension in water and as a dust ; the use of the dust effected economies in man-power, transport and material. Very few large adult swarms resulted, and no crop damage was reported anywhere in Kenya. The last two campaigns were undertaken without army assistance, owing to the demobilisation of the troops. Poison baits and dinitro-o-cresol were both used, and only six swarms resulted in the first of them. The man-power available was inadequate in the second, since numerous swarms entered from October onwards from Somalia and Abyssinia. A large number of escapes occurred, particularly from the Garissa district, and the resulting swarms spread to the south and south-east, many entering Tanganyika.

It is pointed out that these campaigns, the success of which was directly due to the effective co-operation of the army, administration and special staff, averted widespread destruction of crops and consequent famine, and that, with such co-operation, it is possible to control locusts throughout Kenya.

The annual report by T. Y. Watson, Senior Agricultural Officer, Rumuruti, includes a statement (p. 31) that the Tenebrionid, *Dasus simplex*, F., caused

severe local damage to wheat in some of the higher areas of that district, so that several fields had to be replanted.

In the annual report of the Entomologist (Coffee Services) (pp. 51–54), A. R. Melville states that promising results in field experiments on the control of *Diarthrothrips coffeae*, Williams, on coffee in 1944–45, when infestation was not very severe, were obtained with a spray of 3 lb. hydrated lime (fresh, finely ground and of high calcium-oxide content), 8 oz. Paris green and 10 pints molasses in 40 gals. water. The ingredients should be mixed with the water in the order given. When only 1½ lb. lime was included, some scorching of the leaves resulted and there was little improvement in control. Observations indicated that spraying should begin early, and potential outbreak centres should be inspected from September onwards. The spray gave very satisfactory protection in 1945–46, when, following a prolonged dry season and continuous heat, outbreaks were severe and damage amounting to complete defoliation occurred in plantations in which no control measures were employed.

Of the five species of parasites established against *Pseudococcus kenyae*, Le Pelley, on coffee, the only one that appears to give effective control is the species of *Anagyrus* closely allied to *A. kivuensis*, Comp. [*cf. R.A.E.*, A **31** 417]. Investigations have shown that local failures of this species are due to an undescribed hyperparasite, which also attacks an undescribed primary parasite of *Coccus* (*Lecanium*) *africanus*, Newst. In areas in which *P. kenyae* and *C. africanus* occur together on coffee, it is possible for the hyperparasite to transfer from one host to the other, causing a premature reduction in the primary parasites and a consequent loss of control of their respective hosts. Even in the absence of *C. africanus*, the hyperparasite appears able to prevent the species of *Anagyrus* from effecting control when the mealybug occurs on young, vigorously growing suckers coming from near the base of the tree, and this is the commonest cause of failure. The reason for it is not known, but it is possible that when the trees are allowed to produce suckers at the coldest time of the year, the parasite is temporarily at a disadvantage in relation to its host and to its hyperparasite. This is of importance in view of the recent conversion of large areas of single-stem coffee to the multiple system. The virtual cessation of grease-banding for the control of ants that foster the mealybug [*cf.* **20** 395, 670, etc.] has led to a gradual increase in *C. africanus*, which is rapidly destroyed by Coccinellids following grease-banding, and in view of the inter-relation of the two Coccids, outbreaks of *C. africanus* should be controlled by spraying or banding. On single-stem coffee, suckers should be regularly removed; on multiple-stem trees, new suckers have been protected by brushing the mealybugs with methylated spirit at monthly intervals. Unwanted suckers should be removed as early as possible, and an uneven cycle is recommended for established multiple-stem trees, to avoid a continuous area of young suckers of the same age. When parasite failure occurs, control by predators should be encouraged by grease-banding to exclude the ant, *Pheidole punctulata*, Mayr. During a recent shortage of banding grease, 3 per cent. DDT in kerosene, applied as a spray to the lower part of the stem, proved an efficient substitute and remained effective for about six weeks.

Other pests of coffee were *Antestia*, which increased to an injurious extent in certain areas following the continued use of a low-grade pyrethrum powder that was subsequently proved to be ineffective, and *Asterolecanium coffeae*, Newst., which was unusually prevalent and necessitated spraying on many farms.

V. A. Beckley, Senior Agricultural Chemist, refers in the course of his report (p. 77) to an attempt to control termites with smokes of DDT and benzene hexachloride (Gammexane). The insecticide mixtures were in cartridges, and were so quick-burning that a semi-explosion occurred instead of a long-continued smoke. The termites in the nest treated with benzene hexachloride

rapidly became inactive, the holes filled up and no further activity was observed nearly a year later. The treatment with DDT appeared at first to be unsuccessful, since the holes in the nest remained open and clean and a large swarm of flying termites emerged during subsequent rains, but it became evident nearly a year later that the colony had been destroyed. Subsequent experiments with benzene hexachloride were less successful than the first, and further research on both insecticides is considered necessary.

R. H. Le Pelley, Acting Senior Entomologist, reports (pp. 91–92) that the insect pests intercepted on imported plant products in Kenya in 1945 included the sisal weevil, *Scyphophorus acupunctatus*, Gylh., from Tanganyika, and *Cydia pomonella*, L., in apples from South Africa. *Busseola fusca*, Fuller, damaged maize in the Trans Nzoia and Uasin Gishu districts, where it had not previously been a serious pest. He also refers to the finding of *Gonipterus scutellatus*, Gylh., on *Eucalyptus* in Kenya and to the introduction and establishment against it of *Anaphoidea nitens*, Gir. [*cf.* **36** 106].

Chevalier (A.) **Les caféiers du globe. Fasc. III. Systématique des caféiers et faux-caféiers, maladies et insectes nuisibles.**—*Encycl. biol.* **28** 356 [+ 1] pp., 18 pls., 2 figs., 2 maps. Paris, P. Lechevalier, 1947. Price *Fr.* 1000.

This book contains a chapter (pp. 265–317) on the insects and a few other animal pests that attack cultivated coffee, in which information is given on their world distribution and habits, and for the more important species, their morphology, life-history and control, together with notes on the damage caused. Brief sections are included on beneficial insects and on insect pests of stored coffee.

Oxley (T. A.). **The Scientific Principles of Grain Storage.**—$8\frac{3}{4} \times 5\frac{1}{4}$ ins., [5+]103 pp., 2 graphs, 43 refs. Liverpool, Northern Publ. Co. Ltd., 1948. Price 8*s.* 6*d.*

This book on the safe storage of wheat and other grain includes two chapters devoted to the development of insect infestation in grain stored in bulk and its measurement by the amount of carbon dioxide produced [*R.A.E.*, A **32** 243], a third containing notes on the appearance and bionomics of ten of the more important insects that infest stored grain, and a fourth on infestation by mites. Other subjects dealt with are the physical conditions within a grain bulk, the moisture content of the grain and its measurement, the ventilation of storage places, forced ventilation of grain stored in bulk, methods of drying grain prior to storage, spontaneous heating in stored grain and the measurement of the temperature of the grain and the content of carbon dioxide and water in the intergranular atmosphere.

Quidet (P.). **Les parasites animaux du tabac en France.**—127[+ 1] pp., 12 fldg. pls., 126 figs., 1 fldg. chart. [Bergerac, Dordogne, Inst. exp. Bergerac] 1947.

Apart from general accounts of the morphology of insects and the methods that are used to control them, this book consists essentially of two chapters on the animal pests that are injurious to tobacco in the seed-bed and in the field in France. Most of them are insects, and notes are given on the appearance, bionomics and control of these and on the types of injury they cause. It also includes a table enabling the various pests to be recognised from the damage they cause and the time of year at which it occurs, a calendar showing the cultural operations and the pests that are injurious for each month of the tobacco season, and a short chapter on the infestation of stored tobacco.

Farwick (S.). **Zur Kenntnis der Hyperparasiten von** *Pieris brassicae* **L. Über einige Chalcididen als Parasiten von** *Apanteles glomeratus* **L.** [A Contribution to Knowledge of the Hyperparasites of *P. brassicae*. Concerning some Chalcidoid Parasites of *A. glomeratus* L.]—108 pp., 19 figs., 15 pp. refs. Bonn, Inst. PflKrankh. Univ. Bonn, 1947.

This paper on Chalcidoids reared from cocoons of the Braconid, *Apanteles glomeratus*, L., on larvae of *Pieris brassicae*, L., is based partly on material collected by the author, chiefly in western Germany, in 1943–46 and partly on the material from various European countries studied by H. Blunck [*R.A.E.*, A **35** 352]. A list is given of the 25 species of Chalcidoids reared, some of which could be identified only as to genus, and those that have not previously been recorded from *A. glomeratus* on *P. brassicae* are indicated ; another shows the localities from which they were obtained. *Habrocytus poecilopus*, Crwf., *Dibrachys cavus*, Wlk., and *Tetrastichus rapo*, Wlk., comprised about 99 per cent. of the individuals. The adults of the 25 species are described and a key to them is given ; descriptions are also included of the eggs of the six commoner species and of the young larvae of four and the older larvae of seven, together with keys to the larvae. The hosts from which each of 13 of the species has been recorded in the literature as a hyperparasite or a primary parasite are shown in a further list, from which it is concluded that *A. glomeratus* is the preferred host of only five of them, including *H. poecilopus*, *T. rapo* and *D. cavus*.

Laboratory studies of the feeding and mating habits and the mode of oviposition of some of the Chalcidoids are described. In favourable conditions, the adults of *H. poecilopus* and *D. cavus* survived for nearly three months at an average temperature of 18°C. [64·4°F.] and for about six weeks at 28°C. [82·4°F.]. In 30 days, during which a fresh cocoon was offered every day, the females laid 212 and 124 eggs, respectively, of which 10 and 59 per cent. were viable. The egg stages of these species lasted 12 days at 8°C. [46·4°F.], three days at 16°C. [60·8°F.], one day at 23°C. [73·4°F.], and about half a day at 25–32°C. [77–89·6°F.]. The larval stages of *H. poecilopus* and *D. cavus* varied from 10 and 22 days, respectively, at 16°C. to 3½ and 7 days at 32°C. At 10°C. [50°F.] the last instar lasted 3–4 months, and at still lower temperatures all development ceased ; both species overwintered as full-fed larvae in the cocoons of *A. glomeratus* and pupated in spring, the duration of the pupal stage varying from 14 and 19 days, respectively, at 16°C. to 7 and 8 days at 32°C. The parasite larvae do not appear to affect the development of *A. glomeratus* until they reach the fourth instar, when they consume the entire contents of the body. Only single larvae of *H. poecilopus* were observed in cocoons that had been parasitised in the field or in the laboratory, whereas there were usually several of *D. cavus* and *T. rapo* ; the latter, which was the only endoparasite studied, emerges as a full-fed larva from the empty skin of the host. The larva of *H. poecilopus* kills any other individuals present as soon as the latter hatch, whereas larvae of another species of the same genus, thought to be *H. eucerus*, Ratz., apparently kill the other parasites while the latter are still in the egg stage. An average of three and a maximum of six larvae of *D. cavus* or an average of four larvae of *T. rapo* developed within the same cocoon, but numbers much in excess of the average died through lack of food. When *T. rapo* and external parasites were both present, the former usually died.

It is thought that some of the Chalcidoids bred in the experiments may be not only primary parasites of *A. glomeratus* but also sometimes hyperparasites of it. Some of the cocoons collected near Bonn in November 1945 contained living, healthy larvae of *A. glomeratus* and older larvae of Ichneumonids or Chalcidoids, and there were very small escape holes in the cocoons, indicating

that they had also contained individuals that had lived on the eggs or larvae of other parasites present; parasites of corresponding smallness that were bred from this cocoon material comprised, in addition to *Perilampus* sp. and *Ectroma* sp., the Mymarids, *Camptoptera* sp. and *Litus* sp. Other Mymarids, *Gonatocerus* sp. and *Anagrus* sp., were obtained from material collected in other areas, but since the recorded hosts of *Camptoptera*, *Gonatocerus* and *Anagrus* are chiefly plant-sucking insects, the author concludes that most of the Mymarids reared probably bore no relation to *Apanteles*, but had emerged from other hosts that had been collected accidentally. Two females of *Anagrus* sp. were, however, definitely bred from cocoons of *Apanteles*.

Between 1930 and 1946 about 262,280 Hymenoptera were reared from cocoons of *Apanteles* on *P. brassicae*. They comprised 142,930 Chalcidoids, about 82,000 Ichneumonids and 37,350 adults of *A. glomeratus*. It is concluded that about 75 per cent. of the cocoons were parasitised. Of the three predominant Chalcidoids, *D. cavus*, *T. rapo* and *H. poecilopus* comprised about 47, 27 and 26 per cent., but, as *H. poecilopus* is a solitary parasite and the other two are not, these figures indicate that it parasitised about as many cocoons as the other two species together. In view of the great reproductive power of *Apanteles*, the females of which have been stated to lay nearly 2,000 eggs each, the author concludes that even if it is heavily parasitised or even completely destroyed by parasites in some areas, it still effects a high average parasitism of *P. brassicae*.

Schneider-Orelli (O.). **Untersuchungen über Auftreten und Überwinterung des Fichtenborkenkäfers** *Ips typographus*. [Investigations on the Occurrence and Overwintering of *I. typographus*.]—*Schweiz. Z. Forstw.* 1947 no. 3 repr. 23 pp., 4 figs., 12 refs. Berne, 1947. (With a Summary in French.)

The last serious outbreak of *Ips typographus*, L., on spruce in Switzerland occurred in the Grisons in 1900; subsequent attacks by this Scolytid have been limited to single trees, and such damage by bark-beetles as has been observed on small groups of spruce in central Switzerland, has been caused mainly by *Polygraphus poligraphus*, L. In the spring and summer of 1946, however, following a hot, dry summer in 1945, an outbreak of *I. typographus* occurred on small groups of spruce trees over an area extending from central Switzerland to the northern frontier and also in the Jura, Emmental and the cantons of Valais and Ticino. Outbreaks at the same time were reported in southern and central Germany and in Austria.

The adults of the Scolytid and its feeding habits and galleries are described, and observations on the state of infested trees in various parts of the country are recorded. The overwintered adults resume activity in April. Near Salvan, in the valley of the Trient, in Valais, the outbreak had begun in 1945 as a result of damage to the trees by avalanches and strong winds in the winter of 1944–45, and appeared to have passed its peak in 1946. Young adults were present by early June in the bark of trees in sunny positions, and adults developed in trap-logs during August. In Centovalle in the Ticino, in July, beetles were not present in dried out trees that bore numerous galleries, but were found in the tops of otherwise healthy trees.

The adults are generally supposed to overwinter in the trees, either in the galleries in which they develop or in those lower down the trunks made for maturation feeding [*cf. R.A.E.*, A **13** 205], but very few could be found in October in trees in the Ticino that bore numerous brood and feeding galleries or in similar trees in northern Switzerland. During the winter of 1946–47, therefore, the soil at the base of the trees in six localities was examined. In nearly every case, whether the area was one in which the trees had been felled

and barked, or whether they had been left standing, the surface soil, particularly the humus, was found to contain numerous adults of *I. typographus*; males and females were found in approximately equal numbers, and the beetles were most abundant between the roots near the base of the trunks and in places where the humus was deep enough to afford good cover. There were, however, practically no beetles in the soil in part of the Trient valley where all the affected trees had been felled and barked and the pieces of bark destroyed during the summer.

The author reviews the control measures commonly used against *I. typographus* [*cf.* **11** 406, etc.], and points out that since infestation usually begins at the tops of the trees, it is often undetected until the needles at the tip turn yellow, by which time many beetles may have completed their development. Trap-logs should be laid in half-shadow, since full exposure to the sun results in rapid drying of the bark and loss of attractiveness, and full shade in low temperatures that repel the beetles. Both infested standing trees and trap-logs should be barked on sheets so that the bark can be collected and burnt, to prevent the emergence of adults from it. In laboratory experiments, dusts containing DDT or benzene hexachloride were toxic to the adults, though tar-distillate sprays were not, and it is suggested that, when bark is to be removed in late summer, the felled trees and the ground round it should be treated with one of these dusts in case any beetles leave before the operation is complete. Barking has very little value in winter, since most of the beetles overwinter on the ground, but trees felled in winter should be barked before the end of March to prevent attacks in spring by *Trypodendron* (*Xyloterus*) *lineatum*, Ol., or later by *I. typographus*. In areas infested by the latter in the previous year, spruces should be protected by trap-logs before mid-March, and in areas where large-scale felling of damaged trees has been carried out in winter, a trap-long should be left lying until the end of May, to attract adults emerging from hibernation.

Ossiannilsson (F.). **En för Sverige ny bladlus på röda vinbärsbuskar.** [An Aphid new to Sweden on Red Currant.]—*Växtskyddsnotiser* 1945 no. 4 pp. 56–57, 1 fig. Stockholm, 1945.

An Aphid that was found in very large numbers on the stems of red currant bushes in a planting to the south of Stockholm was identified as *Rhopalosiphoninus ribesina*, v. d. Goot, a species previously known only from Holland, England and Latvia. It is recorded in the literature as attacking only red currant, on which it develops all the year round and prefers the older growth; its feeding weakens the bushes, so that the leaves fall early in summer.

Ahlberg (O.). **Ett nytt skadedjur på baljväxtfrön.** [A new Pest of the Seeds of Leguminous Plants.]—*Växtskyddsnotiser* 1945 no. 4 pp. 57–58. Stockholm, 1945.

Seeds of *Lotus corniculatus* and *Medicago falcata* received from a district near Stockholm in the spring of 1945 were found to be infested by larvae of a species of *Bruchophagus* that appeared not to be *B. gibbus*, Boh. (*funebris*, How.), and may prove to be undescribed. Up to 10 per cent. of the seeds were infested, and development was completed in them.

Borg (Å.). **Sparrisflugan ett för vårt land nytt skadedjur.** [The Asparagus Fly, a new Pest for Sweden.]—*Växtskyddsnotiser* 1945 no. 4 pp. 59–60, 1 fig. Stockholm, 1945.

Numerous adults of the asparagus fly, *Platyparea poecilоptera*, Schr., which had not previously been recorded in Sweden, were observed in flight in a market garden near Stockholm in early June 1945. The life-history of this Trypetid

and the damage that it causes to asparagus are reviewed from the literature [*cf. R.A.E.*, A **25** 284, etc.].

SCHWAN (B.). **Bekämpningsförsök mot ärtvecklaren.** [A control Experiment against the Pea Moth.]—*Växtskyddsnotiser* 1947 no. 1 pp. 15–16. Stockholm, 1947.

Experiments on the use of DDT sprays against the pea moth [*Cydia nigricana*, Steph.] in Sweden were begun in 1944. A suspension of a DDT powder gave good results in that year and appeared about as effective as nicotine, but failed completely in 1945. In 1946, an emulsified solution containing 0·05 per cent. DDT was compared with a spray containing 2·2 per cent. nicotine with a wetter. Two or three applications were made at intervals of a week, the first on 8th July, when flowering began, and the pods were examined about a week before harvest. The percentages of pods infested averaged 8·5 and 7 for two and three applications of DDT, and 8·63 and 9·25 for two and three of nicotine, respectively, as compared with 20·25 for no treatment.

LINDBLOM (A.). **Rönnbärsmalen 1946.** [*Argyresthia conjugella* in 1946.]—*Växtskyddsnotiser* 1947 no. 2 pp. 27–30. Stockholm, 1947.

The usual surveys of the prospects of the infestation of apple by *Argyresthia conjugella*, Zell., were made in Sweden in 1946. The fruiting of *Sorbus aucuparia* [*cf. R.A.E.*, A **16** 235] was irregular, and, even in some places where it was above normal, apples were heavily infested. Based on hatching data, spraying dates for apple adapted for different parts of the country were recommended. Two applications of nicotine sprays were made, and good results were in general obtained. Because of the shortage of nicotine, many growers applied two sprays of DDT. These gave good results, especially when applied about a fortnight before the recommended dates for nicotine.

TAHER SAYED (M.). *Aceria mangiferae* **nov. spec.** (*Eriophyes mangiferae* **Hassan MS**) (**Acarina-Eriophyidae**).—*Bull. Soc. Fouad Ier Ent.* **30** pp. 7–10, 6 figs., 4 refs. Cairo, 1946.

Aceria mangiferae, sp. n., the adult female of which is described, infests mango trees of all ages on both light and heavy soils in Egypt. It attacks the inflorescence, which becomes rounded in form, and the terminal buds, causing them both eventually to die. The terminal buds are replaced by lateral ones, which are also infested so that the stem appears stunted and deformed. Such symptoms were first described in 1930, when they were attributed to *Scirtothrips*. They might also be caused by infestations of *Lepidosaphes* crowded round the terminal bud, or by physiological disturbances; similar symptoms were attributed by A. S. Hassan to a mite to which he gave the name *Eriophyes mangiferae* S.N. without describing it [*R.A.E.*, A **34** 19]. The Pyralid, *Cryptoblabes gnidiella*, Mill., the Tineid, *Stathmopoda auriferella*, Wlk., or both, often occur with *A. mangiferae* in the inflorescence. A survey made in 1941 in the Province of Sharkia, which is the main mango-growing area, showed that the mite was present in most mango gardens, but the symptoms were most frequent on young trees.

RIVNAY (E.). **The Status of** *Clausenia purpurea* **Ishii and its Competition with other Parasites of** *Pseudococcus comstocki* **Kuw. in Palestine (Hymenoptera : Chalcidoidea-Encyrtidae and Hemiptera-Homoptera : Coccoidea).**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 11–19, 7 refs. Cairo, 1946.

It is stated in a foot-note that since this paper was written, specimens of the Coccids from *Citrus* known as *Pseudococcus comstocki*, Kuw., in Palestine [*cf. R.A.E.*, A **32** 85] were submitted to American authorities, who found that they

differed from *P. comstocki* of the United States, which is identical with Kuwana's material from Japan. Apple, which is a major food-plant of *P. comstocki* in the United States, is not attacked by the mealybugs in Palestine, even when growing next to heavily infested *Citrus*. In the United States, *P. comstocki* is readily parasitised by *Allotropa burrelli*, Mues. ; large numbers of this Platygasterid were collected on pear infested by *P. comstocki* in Japan and sent to Palestine, but attempts in both field and laboratory to induce it to attack the mealybugs there were unsuccessful.

A recent survey of the status of the parasite, *Clausenia purpurea*, Ishii, in the United States [*cf.* **33** 208] showed that it increases during the summer and decreases in winter, and is not able to check the infestation of apple by *P. comstocki*. In Palestine, *C. purpurea* is active throughout the year, though to a reduced extent in winter and also in the hottest part of the summer [*cf.* **31** 441] when activity by the mealybugs is low ; furthermore, the latter have ceased to be of importance and become extremely difficult to find in some of the groves in which *C. purpurea* is established. The mealybugs continue to spread into new areas in Palestine, but the nature of the attack has changed during the past six or seven years ; infestation, which may be increasing in one grove, is often simultaneously decreasing in a neighbouring one that was attacked at a different time. The summer climate is unfavourable for the mealybugs, and predators and parasites other than *C. purpurea* are also of importance in reducing them [**32** 86]. The relative numbers of the predators, *Scymnus suturalis*, Thnb., *S. fenestratus*, Sahlb., and *S. includens*, Kirsch, vary in different groves ; of the two internal parasites that attack the older stages of the host, *Leptomastix flavus*, Merc., is generally the more numerous, though where it is absent, *Anagyrus kivuensis*, Comp. [*cf.* **32** 86] becomes common. *C. purpurea* quickly dominates the native parasites when introduced into *Citrus* groves, however, as is shown by records of the numbers of the three parasites obtained in counts in each of two groves between September 1943 and June 1944, and in a third between April 1944 and March 1945. The climate favours *C. purpurea* in winter and spring, and is more suitable for *L. flavus* than for *Clausenia* in summer, when, however, host numbers have already been reduced to a minimum by other natural enemies and weather conditions. In the autumn, host numbers again rise, but climatic conditions are then again more favourable for *C. purpurea*. Some unfertilised eggs of *C. purpurea* give rise to females and the ratio of females to males in this species sometimes exceeds 9 : 1, whereas unfertilised eggs of the other two parasites give rise to males only and the sex ratio is generally 1 : 1. Furthermore, *C. purpurea* is not yet parasitised in the field, whereas *L. flavus* is attacked by *Thysanus* sp. [**32** 87] and *A. kivuensis* by *Achrysopophagus aegyptiacus*, Merc. ; the latter hyperparasite was about one third as numerous as its host in one grove in the autumn of 1943. *C. purpurea* was attacked by both hyperparasites in the laboratory, and about 50 per cent. of the pupae originally introduced from Japan were parasitised by *Lygocerus* sp., which, however, was eliminated from the stock by careful breeding.

Moursi (A. A.) & Kamal (M.). **Notes on the Biology and feeding Habits of the introduced beneficial Insect *Leis conformis* Boisd. (Coleoptera : Coccinellidae).**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 63–74, 1 fig., 1 graph, 8 refs. Cairo, 1946.

An attempt was made to introduce the Coccinellid, *Leis conformis*, Boisd., which is predacious on Aphids and Coccids, into Egypt in the autumn and winter of 1936 ; 250 examples in three consignments were despatched by air mail from Australia [*R.A.E.*, A **26** 450], but only five arrived alive and these died within

a few days. In a further attempt in the autumn of 1937, 200 adults and pupae were despatched in two consignments, and three males and three females that had been shipped as pupae survived. The journey lasted 15–17 days ; many adults emerged during it, and a few laid eggs that hatched. The high mortality is attributed to lack of adequate food and to excessive heat over the Malay Peninsula. From the six adult survivors, 586 adults and larvae were reared in the laboratory and these were liberated at five places, including one at Alexandria and two near Cairo. At one of the latter, where releases were made on 10th February and 17th March 1938, two egg masses and a few adults were recovered in February, March and April. No further recoveries were made, but the failure of the Coccinellid to become established is attributed to the small numbers liberated and not to the unsuitability of the habitats selected.

In the laboratory, both fertilised and unfertilised females began to oviposit about 15 days after emerging. The eggs were laid singly or in clusters of up to 50 on both surfaces of *Citrus* leaves and less frequently on leaves of *Duranta* and the walls of the breeding jars. The total number laid by fertilised females varied from 42 to 466. Unfertilised females laid 2–17 eggs singly or in very small clusters, but none hatched. At an average temperature of 23°C. [73·4°F.], the egg stage, the four larval instars and the pupal stage lasted 4, 3, 3·75, 4·14, 6·42 and 6 days, respectively. The rate of development increased as the temperature rose to 25·5°C. [77·9°F.], but decreased at 27·3°C. [81·14°F.]. Adults survived for an average of 87 days when they emerged in early February and 51 days when they emerged between mid-March and early April ; they lived for only six days without food. The Coccinellids attacked *Rhopalosiphum* (*Aphis*) *pseudobrassicae*, Davis, *Aphis durantae*, Theo., *A. gossypii*, Glov. (*citri*, Ashm.), *A. nerii*, Boy., *Chrysomphalus ficus*, Ashm., and *Trionymus* (*Pseudococcus*) *sacchari*, Ckll., in the laboratory, but seemed unable to complete their development on many of them ; they also attacked younger stages of their own species, and the adults are known to feed on plants [**21** 587]. The larvae fed for 16–19 days, during which each consumed 318–441 individuals of *A. durantae* two-thirds grown and seven adults destroyed an average of 1,557 during life.

BARBIER (J.). **Deux Coléoptères nouveaux pour la faune égyptienne.**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 75–76. Cairo, 1946.

One of these beetles is *Pantomorus godmani*, Crotch (*fulleri*, Horn), which was recorded for the first time in Egypt in February 1941, when two adults were taken on ornamental shrubs in Alexandria.

TAHER SAYED (M.). **Contribution to the Knowledge of the Acarina of Egypt. V. Five new Species of Tetranychidae.**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 79–97, 55 figs., many refs. Cairo, 1946.

The new species described in this part of a series on Egyptian mites [*cf. R.A.E.*, A **31** 441] include *Petrobia cepae*, collected on onion leaves in Upper Egypt in spring, *Paratetranychus terminalis* on mango, *Terminalia*, *Eugenia cumini* (*jambolana*) and grape vine, and *Tetranychus* (*Eotetranychus*) *cucurbitacearum*, which is the common red-spider mite of Egypt. Its food-plants include fig, cucurbits, groundnuts, beans (*Phaseolus vulgaris*), broad beans (*Vicia faba*), cotton (*Gossypium barbadense*), Egyptian clover (*Trifolium alexandrinum*), egg-plant (*Solanum melongena*) and several weeds. It is distributed throughout the country and does not hibernate.

Taher Sayed (M.). **Description of *Tenuipalpus granati* nov. spec. and *Brevipalpus pyri* nov. spec. (Acarina : Trichadenidae).**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 99–104, 2 figs., 10 refs. Cairo, 1946.

The author agrees that *Brevipalpus* is distinct from *Tenuipalpus* [*cf. R.A.E.*, A **34** 104] and states that re-examination of the two Egyptian mites recorded in a previous paper [**31** 441] as *T. orchidarum*, Parfitt, on grape vine and pomegranate, and *B.* (*T.*) *oudemansi*, Geijskes, on apple, pear, plum and apricot, has shown them to be new species, which he here describes as *T. granati* and *B. pyri*, respectively.

Taher Sayed (M.). **The Genus *Anychus* McGregor in Egypt and the Sudan (Acarina : Tetranychidae).**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 143–148, 17 figs., 9 refs. Cairo, 1946.

The author now considers that *Anychus orientalis*, Zacher, which occurs on *Citrus* in Palestine and on *Citrus*, castor [*Ricinus communis*], *Melia azadirachta* and *Albizzia lebbek* in Egypt, is not identical with the species present in the Sudan for which he uses the name *A. latus*, C. & F. [*cf. R.A.E.*, A **31** 441]. He describes the adults of both sexes of *A. orientalis* and gives characters distinguishing the two species.

Hussein (M.). **Preliminary Tests on the Use of crude Benzene Hexachloride (or 666) against Locusts and Grasshoppers.**—*Bull. Soc. Fouad Ier Ent.* **30** pp. 155–166. Cairo, 1946.

The results are given of cage experiments in Egypt of the effectiveness of BHC (benzene hexachloride) in baits, dusts and sprays against *Schistocerca gregaria*, Forsk. The BHC used, except in some of the spray tests, contained 13 per cent. γ isomer and was in a 1 : 4 mixture with gypsum.

Baits of wheat bran containing 0·1–1 per cent. BHC were scattered over the floor of the cages in the morning when the locusts showed normal activity, which generally occurred at temperatures of 18–23°C. [64·4–73·4°F.]; they caused paralysis to set in 10–50 minutes later, according to the age of the locusts. A concentration of 0·4 per cent. gave complete mortality of first- and second-instar hoppers in 24 hours, and one of 0·6 per cent. gave complete mortality of third-instar hoppers in 20 hours, of the two later instars in 24 hours and of adults in 36 hours. These concentrations are recommended, as higher ones, which gave more rapid mortality, would be expensive for field use.

In the dusting experiments, both the locusts and their food were treated and various carriers were used to give concentrations of 1–6 per cent. BHC. Dusts containing 1 and 2 per cent. killed all hoppers in the first four instars in periods ranging from 12½ to 24 and 1¼–20 hours, according to their age, and 4 per cent. killed all fifth-instar hoppers and immature adults in 18 and 22 hours, respectively, and is recommended against these stages. The undiluted gypsum mixture (20 per cent. BHC) killed all hoppers in the first three instars within an hour, older ones in 2 hours and immature adults in 6. There was some evidence that immature adults were less resistant than fifth instar hoppers to the weaker dusts.

When the locusts and their food were sprayed with suspensions of the gypsum mixture, 0·2 per cent. BHC gave complete mortality of hoppers in the first three instars in 1·75, 2·75 and 6·25 hours, respectively, but concentrations of 0·8 and 1 per cent., which killed all the fifth-instar hoppers and immature adults in 24 and 18 hours, respectively, were needed to give satisfactory results against these stages. At 2 per cent., the mortality was greatly accelerated. In further

spraying tests, a solution of 7 per cent. γ isomer in decahydronaphthalene and the same diluted with odourless petroleum distillate to give 0·35 per cent. γ isomer both killed locusts in the various stages either instantaneously or in 10–20 minutes, but the solvents are themselves known to be toxic to locusts.

It was noticed in the course of the experiment that hoppers in the first and second instars that were exposed to the baits sometimes died before feeding on them and older hoppers and immature adults immediately after doing so, and that locusts in all stages ate very little of the sprayed or dusted grass, but generally died after shorter periods than when baits were used. In order to determine whether the BHC had any fumigant effect, the gypsum mixture was sprinkled thinly over the floor of a small breeding cage and hoppers in the first four instars were placed on a piece of wire gauze 4 ins. above it. All the hoppers died after periods varying from 14 hours for the first instar to 60 for the fourth. In another test, in which first-instar hoppers of *S. gregaria* and other Acridids were liberated in cages that had been used for the dusting experiments and subsequently thoroughly washed with water and dried, all died in 24 hours. Locusts poisoned by BHC in baits, sprays or dusts almost all showed the same symptoms ; after remaining motionless for a short time, they entered a period of intense activity, which was followed by paralysis, with some movements of the hind legs, and death.

The odour of BHC is unpleasant and persists in an enclosed environment. Workers handling it suffered from heavy breathing and coughing and inflammation of the skin, especially round the eyes ; many of these effects are avoided when it is applied or mixed in the open. Goats given about 50 gm. BHC daily with their food suffered paralysis and death after several weeks. These results indicate that BHC is far less toxic to domestic animals than sodium arsenite. In tests of phytotoxicity, a 5 per cent. suspension and the 20 per cent. dust were applied to wheat, barley, flax and various leguminous plants growing in pots, a number of trees, including *Citrus* spp., rice-fields and patches of green clover, but no injury was observed. The plants in pots were also sprayed with the two solutions of the γ isomer, which caused the foliage to dry out completely in 48–72 hours and 5–7 days, respectively ; the solvents were probably responsible.

In a test of the stability of BHC when exposed to the atmosphere in baits, wheat bran containing 2 or 3 per cent. was dried in the sun for three days and then stored in calico bags for 30 days, after which it was moistened with the same amount of water as was required for a fresh bait and tested against fifth-instar hoppers of *S. gregaria*. Fresh baits at these concentrations gave complete mortality in 14 and 8 hours, respectively, but the old ones required 120 and 96 hours.

Lever (R. J. A. W.). **The Aphids or Green Flies of Fiji.**—*Agric. J. Fiji* **17** no. 3 p. 81. Suva, 1946.

A tentative check list is given of the Aphids of Fiji, with the economic plants they attack. They comprise, in addition to *Pentalonia nigronervosa*, Coq., which transmits bunchy top disease of bananas [*cf. R.A.E.*, A **27** 213], *Aphis gossypii*, Glov., on cotton, taro [*Colocasia*], rice, beans, cowpeas, guava, *Hibiscus rosa-sinensis* and rattlepod (*Crotalaria mucronata*) ; *A. maidis*, Fitch, on maize ; *A. citricidus*, Kirk. [on *Citrus* (*cf.* **29** 389)] ; *A. nerii*, Boy., on false ipecacuanha (*Asclepias* sp.) ; *Cerataphis lataniae*, Boisd., on coconut, ivory palm (*Metroxylon vitiensis*) and banana ; *Toxoptera aurantii*, Boy., on *Cassia fistula* and cacao ; *Rhopalosiphum nymphaeae*, L., on water hyacinth [*Eichhornia*] ; *R. pseudobrassicae*, Davis, *Myzus persicae*, Sulz., and *Macrosiphum* sp. on radish ; and *Oregma* [*lanigera*, Zehnt.] on the native reed grass, *Miscanthus*

japonicus. The chief predators of Aphids are larvae of Coccinellids, including *Coccinella repanda* var. *transversalis*, F., and *Coelophora inaequalis*, F., and of Syrphids, especially *Xanthogramma* (*Ischiodon*) *scutellare*, F., and *Syrphus corollae* var. *vitiensis*, Bez.

KELSEY (J. M.). **Tests with Timber Preservatives in New Zealand.**—*N.Z. J. Sci. Tech.* **27** (B) no. 6 pp. 446–457, 4 refs. Wellington, N.Z., 1946.

Small-scale experiments with wood preservatives were carried out in New Zealand in 1943–46 under optimum conditions for infestation by *Anobium punctatum*, Deg. [*cf. R.A.E.*, A **36** 245]. The main object was to evaluate the preservatives used for controlling borer infestation in buildings, though they were also tested for its prevention. The water-soluble preservatives used were Tanalith (a Wolman salt containing sodium fluoride, sodium chromate, sodium arsenate and dinitrophenol), applied in a 2 per cent. solution to give an average dry salt retention of 0·25 lb. per cu. ft. timber; Celcure (which consists of potassium dichromate, copper sulphate, acetic acid or an acetate and sometimes a small amount of boric acid), applied as a 4°Twd. solution to give an absorption of 5·1 gals. per cu. ft.; and zinc chloride, applied as a 4 per cent. solution (by weight) to give an average dry salt retention of 1 lb. per cu. ft. The oil-soluble preservatives were Boracure, which is reported to consist of pentachlorphenol, pine oil and Standesol (5 : 1 : 94); home-made solutions of 5 per cent. pentachlorphenol with pine oil and Standesol (1 : 94), linseed oil and kerosene (2 : 93) or pine oil and kerosene (2 : 93), which are referred to as K1, K2 and K3, respectively; Rentokil, reported to contain chlorinated naphthalene in a mixture of vegetable and mineral oils; Timber Treatments, of which the principal ingredient is zinc naphthenate in mineral oil solvents; kerosene; a mixture of kerosene and turpentine (1 : 1); and 5 per cent. solutions of paradichlorbenzene or orthodichlorbenzene in kerosene.

The tests consisted of egg-laying experiments with adult females of *Anobium*, which were subdivided into compulsion tests, in which each cage contained blocks treated with a single preservative, and preference tests, in which each contained treated and untreated blocks, larval-susceptibility tests in which *Anobium* larvae were transferred from untreated timber to holes drilled in treated blocks, and tests in which timber infested with *Anobium* larvae or *Kalotermes* (*Calotermes*) *brouni*, Frogg., was brushed with the preservatives. The timbers used for egg-laying tests were well seasoned, air-dried, sapwood blocks of *Podocarpus dacrydioides*, *Dacrydium cupressinum* and *Pinus radiata*. The last was the only one used in larval transfer work, and well-seasoned, air-dried sapwood of *Podocarpus spicatus* and *P. dacrydioides* were employed for brush treatment against *Anobium* and *K. brouni*, respectively. Tanalith and Celcure were applied by commercial pressure treatments, in 1945 and 1940, respectively, and solutions of zinc chloride and the oil-soluble materials by submerging blocks in them until tests showed that they were completely penetrated, except in the brushing tests. The times taken to secure complete penetration varied greatly, and were in general two-fifths as long for the oil-soluble materials as for the water-borne zinc chloride. The treated timbers were tested after various periods of seasoning.

The results of the egg-laying compulsion tests indicated that kerosene alone and turpentine, paradichlorbenzene and orthodichlorbenzene with kerosene were unlikely to prove permanently toxic to *Anobium*, since although they all prevented infestation during the first flight season after treatment, the protection afforded became progressively weaker in the second and third year of seasoning. The larvae recovered were healthy, and frass pellets indicated that feeding had been extensive. Many more larvae survived in wood treated with

zinc chloride during the second and third years after treatment than during the first, but none of them appeared to be normal, and examination of dust in the tunnels showed that much of the wood had been chewed but not passed into the gut. This compound had no significant deterrent effect on oviposition. Tanalith and Celcure were tested only during the flight season of 1945–46. They had no significantly deterrent effect on oviposition, and there was feeding in each case. Pentachlorphenol, zinc naphthenate and chlorinated naphthalene were effective for the periods tested, 2, 3½ and 1 year after treatment, respectively, and the results, for the first two at least, were not due to the solvents or carriers. The adults did not live for more than five days when caged with timber treated with any of these three materials, and in no case were any eggs laid.

The results of the egg-laying preference tests confirmed that none of the water-soluble preservatives prevented oviposition. Larval survival was fairly high in zinc-chloride blocks, though less than in untreated ones, and also in the Tanalith and Celcure blocks during the three months that they were tested.

When larvae were transferred to treated wood, all the oil-soluble preservatives gave complete control, and though the samples were examined at intervals of eight months, they killed the larvae in less than two months. Although the water-soluble materials made the wood unpalatable to the larvae and prevented transformation to pupae or adults, the lengths of the tunnels were about the same as in untreated blocks, and it is recommended that the amount of toxicants in these preservatives should be increased if possible.

Examination 49 days after treatment showed that brushing the preservatives over wood (4×1 in. floor boards) infested by larvae of *Anobium* was consistently more effective when the upper surface was treated than when the lower or vertical surfaces were, but the differences were not great. It was apparent that none of the materials tested, with the exception, possibly, of the chlorinated naphthalene, should be used in quantities of less than three flood coats per inch of timber thickness for the sapwood of *Podocarpus spicatus* or species of equal penetrability. Chlorinated naphthalene, pentachlorphenol and zinc naphthenate all appeared to be good preservatives for the treatment of infested sapwood of *P. spicatus*; kerosene and paradichlorbenzene in kerosene gave fairly good control, but were considered unlikely to afford a reasonable period of protection. The surviving larvae were all found just below the surface on the sides opposite to those treated, or, in the case of vertical treatments, nearly all in the top third. The average percentage mortalities caused by the third and fourth coats for all three surfaces were 96·43 for chlorinated naphthalene, 88·33 and 85·47 for pentachlorphenol K1 and K2, and 80·31 for zinc naphthenate, and it was found that four coats of chlorinated naphthalene or pentachlorphenol K1 were the best treatment of all; that three coats of chlorinated naphthalene were better than four of the pentachlorphenol K2 or zinc naphthenate; that two of chlorinated naphthalene were almost equal to three of zinc naphthenate; and that one of chlorinated naphthalene was almost equal to two of pentachlorphenol K1 or K2 and better than two of zinc naphthenate. The pentachlorphenols were approximately equal in effect and better than zinc naphthenate, except for single coats of the latter, which were better than the pentachlorphenol K2. In general, it is recommended that one liberal brush coating should be applied for each quarter inch in thickness of sapwood timber. In commercial practice, surface spraying, which is much quicker, has superseded brushing, but it is unlikely that there would be much difference between the two methods in penetration and the amounts of fluid required.

When the upper surface of wood (6×1 in.) of *P. dacrydioides* infested by *K. brouni* was brushed over with pentachlorphenol, chlorinated naphthalene or zinc naphthenate and the wood examined after 21 days, all three were found

to have given good mortality, though it was evident that even three coats may not kill all the termites if their galleries are narrow and on the side opposite to that treated. However, if the galleries are numerous and approach both surfaces, a single application of any of these preservatives might prove effective, since the surviving termites in all treated wood were shrivelled and probably would not have lived much longer.

From the results obtained it is concluded that although kerosene, kerosene and turpentine, paradichlorbenzene and orthodichlorbenzene give good control of insects already present in timber, they are unlikely to prevent future infestation, and it is recommended that their use should be discontinued. Of the water-soluble preservatives, zinc chloride is the only one on which oviposition tests were carried out for longer than three months, and although the numbers of surviving larvae were often high, their condition showed that the treated wood was unpalatable to them. Larvae of *Anobium* were able to tunnel in wood treated with oil-soluble preservatives for almost three weeks, provided that there was no free liquid in cell cavities or on wood fibres. Examination of the tunnels showed that dust made before treatment consisted almost entirely of frass pellets, whereas that made after it contained practically no frass, showing that after treatment the wood had been chewed but not passed into the gut. In subsidiary experiments to find how long they could live without food, second- and third-year *Anobium* larvae were kept at room temperatures in jars containing damp, crumpled cellophane disks and examined each week. More water was added if necessary. Of 50 larvae, 19 were alive at the end of four weeks, five after 35 days and none after 37, indicating that in the absence of desiccating factors, *Anobium* larvae can survive for long periods without food. This is important in interpreting the effects of timber preservatives, since the value of those that are not contact insecticides will become apparent only when larvae are compelled by starvation to eat treated wood, which may not occur for three or more weeks. In the experiments described, no samples were retained for longer than a year, so that it is not known whether the surviving larvae would have succumbed after longer exposures.

Records of the use of some of these preservatives in other countries are reviewed in an appendix.

ROBERTSON (P. L.). **Note on Tyroglyphid Mite Species on Cheese in New Zealand.**—*N.Z.J. Sci. Tech.* **27** (B) no. 6 p. 486, 1 ref. Wellington, N.Z., 1946.

A survey made in the course of an investigation into methods for the protection of cheese from mite attack under wartime storage conditions in New Zealand [*cf. R.A.E.*, A **36** 244] showed that most of the factory curing rooms are without temperature control and generally contain infestations of a species of *Tyrophagus* referred to as *T. longior*, Gerv. [*cf. R.A.E.*, A **31** 69, 157] and *Tyrolichus casei*, Oudm., particularly on reject cheese, which is often left undisturbed for many months. In bulk cool stores, where cheese for export may be kept for some months, generally at temperatures between 40 and 50°F., a different series of mites was found and only a few isolated examples of *Tyrophagus* were observed. They included *Tyroglyphus farinae*, Deg., which possibly lives on the mould that is generally found in association with infestations in cool stores, although a colony proved capable of establishment and development over a period of several months on the surface of fresh cheese in the laboratory, *Glycyphagus* (*G.*) *domesticus*, Deg., a species regarded as secondary and probably living on mould, and *G.* (*Lepidoglyphus*) *destructor*, Schr., which has similar food habits to *G. domesticus*.

WRIGHT (D. W.) & ASHBY (D. G.). **Bionomics of the Carrot Fly (*Psila rosae* Fab.). II. Soil Populations of Carrot Fly during Autumn, Winter and Spring.**—*Ann. appl. Biol.* **33** no. 3 pp. 263–270, 7 figs., 6 refs. London, 1946.

In view of the diversity of opinion on the behaviour of larvae of *Psila rosae*, F., during autumn and winter and the times at which they pupate [*cf. R.A.E.*, A **16** 40 ; **30** 519], investigations were carried out in East Anglia in 1943–45. Larvae in all stages of growth occur together in the soil, there being present at the same time young larvae that have recently hatched and large fully grown larvae about to pupate as well as larvae in intermediate stages migrating from carrot to carrot. The numbers of puparia in the soil vary greatly from autumn to spring. The following is based on the authors' summary. The results show that both larvae and pupae overwinter, and that the proportion of the individuals in each stage varies from crop to crop and from season to season. Samples taken from a plot sown in May 1943 showed that pupation, which was 45·2 per cent. complete in October, rose to 74·2 per cent. in March and was not entirely complete until late April. From a plot of carrots sown in June 1944, samples showed a rise in percentage pupation from 8·6 per cent. in October to 93·5 per cent. in March, the process probably being complete by early April. The changes in proportion of the soil larvae, carrot larvae and puparia in both the May and June plots were followed and are shown graphically. The changes in the size groups of the soil larvae and in the carrot larvae were also traced. The immature larvae persist longer in the carrots than in the soil. The size composition of the larvae from the soil of the June plot was recorded from September to April, and the results are given graphically. Samples taken in October 1945 contained fully developed second-generation puparia from which flies emerged in a few days. These flies gave rise to progeny that overwintered in the larval stage. The population in December, 1945, composed chiefly of second-generation puparia and third-generation larvae, was very similar to that occurring in the previous two years. Mortality among the overwintering larvae and puparia varied considerably,but was frequently heavy. The principal agencies concerned [*cf.* **35** 213] were *Dacnusa gracilis*, Nees, and fungous and bacterial diseases. Other insect parasites occasionally important were *Loxotropa tritoma*, Thoms., and *Aleochara sparsa*, Heer. Nematode parasites were also recorded.

SOLOMON (M. E.). **Tyroglyphid Mites in Stored Products. Nature and Amount of Damage to Wheat.**—*Ann. appl. Biol.* **33** no. 3 pp. 280–289, 15 refs. London, 1946.

The following is almost entirely the author's summary of experiments and observations in England on the damage done by *Tyroglyphus farinae*, Deg., to stored grain, mostly wheat, and methods of assessing it. Previous observations that the mites cannot penetrate wheat grains if the grain-coat is intact were confirmed ; usually less than 10 per cent. of the grains are intact near the germ in Manitoba wheat. In experiments in which colonies of mites on wheat grains or wheat-germ flakes were kept in small tubes under controlled conditions, the mites consumed up to 3 per cent. by weight of the grain before dying out ; they were able to destroy the germ completely, but consumed very little of the remainder. The maximum rate of consumption observed over a six-week period was 0·29 per cent. of the grain weight per week ; when added to grain at 75 per cent. relative humidity in the proportion of 1 per cent. by weight, mites consumed 1 per cent. of the grain in 27 days at 21°C. [69·8°F.] or in 37 days at 10–15°C. [50–59°F.]. Although they consumed the grain more rapidly at higher temperatures or humidities, they survived longer at

lower temperatures or humidities, and the ultimate damage under these conditions was greater. The mites consumed wheat-germ flakes more rapidly than grain, and finally reduced their weight by 74–85 per cent.

Symbols are suggested representing various degrees of damage to grain by mites, based on the proportions of grains with damaged embryos and with embryos completely destroyed, which can readily be determined by microscopic examination, and approximate values for the equivalent weight losses are given. The relation between the degree of damage to the grain and the product of the density of the mites (expressed as number per 100 cc. grain) and the time in weeks was calculated from experimental data ; the damage done per unit of this product was 2–2·5 times higher at 25°C. [77°F.] than at 5–9°C. [41–48·2°F.] and about 1·4 times higher at 70 than at 90 per cent. relative humidity. The mean product value corresponding to 1 per cent. loss of grain weight was 526,000 at 25°C. and 1,765,000 at 5–9°C.

Data from granary investigations are given to show the degree of damage associated with various levels of population density and grain moisture. In infested storage places, the amount of embryo material destroyed ranged from less than 1 per cent. of the total in grain stored in bulk to about 15 per cent. in grain in bags. Mites can cause a rise in the temperature or moisture content of grain, or an increase in the growth of micro-organisms, but there is no evidence to suggest that serious damage from these causes is likely, except that dense infestation can cause heating.

Lucas (C. E.) & Oxley (T. A.). **Study of an Infestation by *Laemophloeus* sp. (Coleoptera Cucujidae) in bulk Wheat.**—*Ann. appl. Biol.* **33** no. 3 pp. 289–293, 1 fig., 7 refs. London, 1946.

Species of *Laemophloeus* are generally considered to be secondary pests of stored grain, but instances in which they were the primary or dominant pest became common in Britain in the later years of the war and also occurred in Canada [*cf. R.A.E.*, A **34** 320 ; **35** 99]. In November 1944, such an infestation was studied at Birkenhead in Canadian wheat stored in an open-topped silo bin about 65 ft. (19·9 m.) deep that had been filled in the previous March, and the conclusions reached were confirmed by less detailed observations on two of the other bins. Deep sampling of the grain was carried out by means of an apparatus, of which an improved form is described elsewhere [see next abstract], capable of taking 200-gm. samples in vertical series at intervals of 1 m. The methods of sampling and measuring the temperature and moisture content of the grain and the concentration of carbon dioxide in the intergranular spaces at various depths are described. Only 36 mites and insects other than *Laemophloeus* were found in or bred from 23 samples of grain, obtained from different depths. The species of *Laemophloeus* concerned appeared to be *L. minutus*, Ol., but the female genitalia differed from those described by Reid [**30** 502]. Larvae of *Laemophloeus* were hitherto thought to be free-living, but discrepancies between the numbers of larvae found and the rate of production of carbon dioxide in some samples [*cf.* **32** 243], notably those from depths of 1 and 2 m., suggested a possible intragranular population, the presence of which was subsequently shown by rearing experiments. Dissection of some 200 grains indicated that infestation was limited to the germs, and in these most larval stages and pupae were found. Laboratory observations at Slough have since shown that *L. minutus* can pass part or nearly the whole of its life-history within wheat grains. Few of the larvae in the samples first examined were free-living, but the proportion became larger as breeding-out continued, though it varied from sample to sample and was smallest when the number of insects that emerged from a sample was large. The cannibalistic tendencies of the

adults under certain conditions may be responsible for this reduction. Living adults and larvae and dead insects were present throughout the grain, but living insects were most numerous at depths of 0·5–3 m. from the surface and there was a smaller peak at 8–11 m. The distribution of the population was closely correlated with the temperature of the grain at depths down to about 11·5 m., below which temperature readings were not taken. At a point about 1m. below the surface, the temperature reached 35°C. [95°F.] and larvae were considerably more abundant than adults; the latter reached small peaks immediately above and below the hot region and had evidently moved away from it. This represents a late stage in the interaction between insect populations in grain and the heat produced by them, and the situation at the deeper peak an early one in which the population is increasing and producing a slight rise in temperature. The water content of the grain at different levels was much less variable, but reached peaks just above each zone of high population and temperature, evidently as a result of local convection currents set up by the temperature gradient. Concentrations of intergranular carbon dioxide were generally low; they were not clearly related to population and were negligible at the hottest and most populous region, possibly because of the development of intense local convection currents in which replacement by cold air was from the sides of the bin. Dead adults were in general numerous where living insects were abundant, but were also plentiful at the bottom of the bin. Living insects were scarce there, and the dead ones evidently represented a past population that must have been present for a considerable period, since it was probably not more dense than that observed in other parts of the bin. It is unlikely that the deep central infestation observed could have developed from initial infestations at the walls of the bin or the surface of the grain in the eight months during which the grain had been left undisturbed. More probably, a light and fairly evenly distributed infestation had been present for a considerable period, and similar small differences in infestation when the bin was filled were responsible for the final irregular distribution.

Lucas (C. E.) & Glover (R. S.). **On making Measurements in Silo-stored Grain.**—*Ann. appl. Biol.* **33** no. 3 pp. 293–302, 1 pl., 4 figs., 4 refs. London, 1946.

When it became necessary in 1942 to examine samples of grain taken from various depths in wheat stored in silos in England, the only apparatus available was a sampling spear that could be inserted by means of extension rods to a depth of 15 m., but took only one sample per insertion. A more robust sectional probe was then designed to take a series of samples at intervals of 1 m. and was extensively used; it proved practicable down to depths of 15 m. or more and was rigid enough to be used even in incompletely filled bins, but did not allow the ports to be closed after sampling, so that the samples were liable to become contaminated during withdrawal. This and certain mechanical defects were overcome in an improved sectional sampler that is described and figured. It is made of steel throughout, and took samples of 350–360 gm. each.

To obtain simultaneous records of temperature, thermocouple ropes 100 ft. in length with six couples at intervals of 5 m. or nine at intervals of 2 m. were used, and the second arrangement was found to be the more satisfactory. The ropes were inserted to the required depth, left for 20 minutes to reach temperature equilibrium, and, after the record was made, raised through a distance of 1 m. for the next reading. Ropes 2 m. long with couples at intervals of 25 cm. were useful for temperatures near the grain boundaries. Samples of intergranular gases were collected by specially designed stainless steel capillary tubing through which the gas passed into evacuated glass bulbs after the gases already in the tubing had been extracted by means of a gas syringe. An

attempt was made to insert the thermocouple ropes and the capillary tube by attaching them to the spearhead of the grain sampler, but this procedure imposed undue strain on the thermocouple rope and, owing to the bulk of metal in the sampler, a longer period was required for the temperature to reach equilibrium. They were therefore attached to a special solid spearhead and inserted by means of extension rods, which were withdrawn immediately afterwards.

Experience with covered, but not air-tight, bins showed that samples of gases from the superficial layers could be obtained with minimum losses before the manhole lid was removed, either through the small holes commonly present in the lid or by slightly opening it. Samples of superficial grain should be collected as soon as the lid is opened, and the temperatures in the subsurface grain should be recorded by mercury thermometers without delay, since they may change quickly when a heating bin is opened. The temperature records and gas samples should probably be taken before the grain samples are collected, as this is a longer process.

It had been expected that serial samples taken from the grain stream or conveyor belt during the emptying or filling of a bin would give reliable estimates of the conditions within it, but this method gave irregular results in practice. Extraneous seeds, insects, holed grains and other such material were segregated so that they were delayed in the outfall while a bin was being emptied and were more concentrated in the central column of a bin after filling. Segregation also occurred during the sampling process, so that extraneous material was scarcer in the first part of the sample to fall into the container. When grain is in motion on a conveyor belt, the vibration causes large light objects, such as oats and holed grains, to settle on the surface of the wheat and smaller ones to sink between the grains ; the distribution of living adult insects, which probably cling to the grains, does not appear to be affected. These observations indicate that the principles of sampling need revision ; results obtained with any one type of sampler should be comparable, but data from different types may differ appreciably.

HEWLETT (P. S.). **The Design and Performance of an atomizing Nozzle for Use with a spraying Tower for testing liquid Insecticides.**—*Ann. appl. Biol.* **33** no. 3 pp. 303–306, 2 figs., 1 ref. London, 1946.

In experiments using the spraying tower devised by Potter [*R.A.E.*, A **29** 591], difficulty in re-adjusting the atomising nozzle after dismantling prevented good replication of the deposit of insecticide. An improved nozzle was therefore designed and is described in this paper. It can be adjusted more easily and precisely and the standard deviation of deposit given by it was one-seventh that given by the original one. It is stated in a footnote that another nozzle incorporating still further improvements in adjustment has since been designed.

SUN (YUN-PEI). **A preliminary Study of the Influence of Velsicol AR-60 upon the insecticidal Effectiveness of Dusts containing Rotenone or DDT.**—85 pp., 13 refs., multigraph. Ithaca, N.Y., Dep. Ent. N.Y. St. Coll. Agric., 1946.

An account is given of experiments in New York in which Velsicol AR-60, which consists mainly of di- and tri-methyl naphthalenes, was tested alone and in combination with cubé and DDT in dusts against 14 different insects in the laboratory, the greenhouse or the field. The cubé dusts were prepared by mixing the cubé powder with talc and adding the Velsicol, and the DDT dusts by dissolving DDT powder in Velsicol with gentle heat and adding pyrophyllite to the hot solution.

In tests of the effects of Velsicol dusts on plants, 4 per cent. Velsicol did not injure cabbage, cauliflower, turnip, beans, peas, cucurbits or solanaceous vegetables, but injured Chinese cabbage, lettuce and spinach. Dusts containing 3–4 per cent. Velsicol alone were moderately toxic to most of the insects tested in the laboratory, and the addition of 1–4 per cent. Velsicol increased the effectiveness of cubé and DDT to all the insects tested. The numbers of young produced by *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) and *Brevicoryne brassicae*, L., were increased by cubé and decreased by Velsicol, as already shown for *Aphis fabae*, Scop. (*rumicis*, auct.) [*R.A.E.*, A **34** 143]. Higher concentrations were usually required in the greenhouse to produce the same mortality as in the laboratory, but Velsicol again increased the effect of cubé and DDT. The same effect was usually, but not always, observed in the field tests. Thus, the mortality percentages given by 0·42 per cent. rotenone were 29·1 for *Trichoplusia ni*, Hb. (*Autographa brassicae*, Ril.), 85·7 for *Pieris rapae*, L., and 95·2 for *Phyllotreta vittata*, F., all on crucifers, as compared with 8·7, 82·6 and 95·2, respectively, for 0·17 per cent. rotenone with 2 per cent. Velsicol against the first two and 0·25 per cent. rotenone and 3 per cent. Velsicol against the last, while the addition of 3 per cent. Velsicol increased the percentage mortality of larvae of *Epilachna varivestis*, Muls., on beans given by 0·083 per cent. rotenone only from 94·6 to 95·5. Whereas 5 per cent. DDT alone gave 34·3 and 74·6 per cent. mortality of *E. varivestis* on bean and *A. fabae* on nasturtium, and 2 per cent. gave 100 and 98·8 per cent. mortality of *Empoasca fabae*, Harr., on potato and *M. onobrychis* on lucerne, 2 per cent. DDT with 3 per cent. Velsicol killed 66·7, 99·5 and 100 per cent. of the first three of these and 1 per cent. DDT with 2 per cent. Velsicol 95·7 per cent. of the last.

It is concluded that Velsicol is a useful addition to DDT and rotenone dusts.

PROVERBS (M. D.) & MORRISON (F. O.). **The relative insecticidal Activities of DDT and related organic Molecules.**—*Canad. J. Res.* (D) **25** no. 1 pp. 12–44, 19 figs., 20 refs. Ottawa, 1947.

The following is largely the authors' abstract. Impregnated filter paper, coated glass substrata and direct sprays were employed to test the relative toxicity of several organic compounds related to DDT as contact insecticides, the test insects being adults of *Drosophila melanogaster*, Mg. Anaesthetising the flies for convenience in handling did not affect observed mortalities. In general, both impregnated paper and coated glass (vial) techniques gave reproducible results. The former resulted in an unexplained drop in mortalities above a certain dosage level, but the latter gave somewhat more uniform results. Direct spraying was superior when the chemical had a fumigant as well as a contact effect.

The materials tested were DDT, its difluoro, dibromo and di-iodo analogues, and its o-p isomer; 1,1-bis-(p-methylphenyl)-,1,1-bis-(p-bromomethylphenyl)-, 1-phenyl-1-p-chlorphenyl-, and 1,1-diphenyl-2,2,2-trichlorethane; 1,1-bis-(p-chlorphenyl)-2,2-dichlorethane (DDD); 1-(4-chlorphenyl)-2,2,2-trichlorethanol (carbinol DDT); p-chlor-α-trichloracetophenone, p-chlor-α-dichloracetophenone and p-chloracetophenone; p-p- and o-p-dichlorbenzophenone; bis-(p-chlorphenyl)sulphone; p-dichlorbenzene; and the γ isomer of benzene hexachloride. Of these, only the last and the difluoro analogue of DDT exceeded DDT in effectiveness. Benzene hexachloride showed a strong fumigant effect and its deposits had prolonged toxicity, whereas the fluorine analogue lost toxicity rapidly. Removal of one or both phenyl chlorine atoms from the DDT molecule, alteration of their positions or their replacement by any radical other than fluorine, interference with the trihalogen group of DDT

or the introduction of a double bond into the molecule all seriously reduced insecticidal action. The iodine analogue of DDT was less toxic than the bromine analogue.

SMITH (K. M.). **Tobacco Rosette : a complex Virus Disease.**—*Parasitology* **37** no. 1–2 pp. 21–24, 2 pls., 2 refs. London, 1946.

The author gives an account of experiments showing that a disease found in tobacco received from Southern Rhodesia and Nyasaland, for which the name tobacco rosette has been suggested [*cf. R.A.E.*, A **27** 125 ; **29** 153 ; **34** 206] is caused by the joint action of two viruses [**34** 70]. He describes the symptomatology of the component viruses, alone and in combination, and the histopathology of the rosette disease ; the disease studied by Wickens in Southern Rhodesia [**27** 226] probably represents the same complex.

Inoculation experiments showed that only one of the viruses was sap-transmissible, though both were carried very efficiently in combination by the Aphid, *Myzus persicae*, Sulz. The name mottle virus is provisionally suggested for the sap-transmissible virus, after its chief symptom, and vein-distorting virus for the other, which induces curvature of the veins of the leaves with some stunting of the plant. Neither virus singly produces the gross distortion of the plant characteristic of the double infection.

In a long series of insect-transmission tests in which the infected Aphids were transferred 20 times at 24-hour intervals to fresh seedlings of White Burley tobacco, infection with both viruses persisted to the end, but occasional plants in the series became infected with the mottle virus only. It was not until much later in the work that a case occurred in which the Aphid transmitted the vein-distorting virus only, and so enabled it to be obtained in pure culture. Aphids that had fed for some days on a tobacco plant infected with rosette were colonised on cabbage (which is immune to the rosette complex) and three were transferred to each of three healthy tobacco plants on each of the seven following days. These 21 plants all developed rosette disease, indicating that both viruses are of the persistent type in relation to the Aphid vector [*cf.* **29** 26].

M. persicae is not a specific vector of rosette, since successful transmissions were obtained with *Macrosiphum* (*M.*) *pseudosolani*, Theo., which, however, appeared to be a less efficient vector. *M. solanifolii*, Ashm. (*gei*, auct.) was also tried but the results were rather uncertain. There is no evidence that either of the viruses is carried in the seed.

The complex was fairly easily transmitted to tomato if seedlings were colonised with infective Aphids, and was also transmitted to *Atropa belladonna*, which, after a temporary reaction, apparently carried the viruses without symptoms, and to *Nicandra physaloides*.

SMITH (K. M.) & LEA (D. E.). **The Transmission of Plant Viruses by Aphides.**—*Parasitology* **37** no. 1–2 pp. 25–37, 7 figs., 8 refs. London, 1946.

This paper contains an account of further laboratory experiments on the transmission by the Aphid, *Myzus persicae*, Sulz., of the complex of viruses causing tobacco rosette [*cf.* preceding abstract] and a detailed analysis of the published results of similar experiments carried out with other viruses.

The plants used in the infection tests were small tobacco seedlings of the variety White Burley. The Aphids were put on the experimental plants, covered with a lamp chimney or glass tumbler and allowed to feed for the necessary period, after which they were removed with a camel's hair brush, and the plants were sprayed with nicotine and kept under observation. The

stock cultures of *M. persicae* were kept mainly on non-solanaceous plants, to avoid accidental contamination with the viruses under study, which appeared to attack only Solanaceae. In experiments in which the Aphids were allowed to feed for up to 24 hours on plants infected with the complex or with the vein-distorting virus only, and then transferred to successive healthy plants every 24 hours for up to ten days, they were less infective during the first 48 hours on healthy plants than subsequently, showing that there is a latent period such as has been demonstrated with other persistent viruses [*cf. R.A.E.*, A **29** 26]. After periods of 2–7 days' feeding on infected plants the Aphids were little if at all less infective during the first 24 hours on healthy plants, evidently because the latent period was over before feeding on the healthy plants began. There was no clear evidence of any systematic change in the infectivity of the Aphids after the latent period was over, infectivity apparently remaining approximately constant until the end of the experiment. In the experiments with the rosette source, some of the plants became infected with the complex and some with mottle virus only, but in two similar experiments using a plant infected with mottle virus only as the source, no infections were obtained, and further tests confirmed that the Aphid is apparently unable to pick up the mottle virus when this exists alone in the plant. Detailed examination of the results of one of the tests showed that of 20 Aphids, each of which was tested successively on five plants, three gave no infections, six gave one, four gave two, two gave three, four gave four and one gave five infections. Comparison of these and similar results with those calculated on the binomial distribution showed that in all cases more Aphids than expected produced extreme numbers of infections (many or few) and fewer produced intermediate numbers, presumably because the Aphids were not all equally infective, although they were subjected as far as possible to similar conditions of feeding on the source of infection. This was confirmed by the fact that the Aphids that produced infection on the first day after the end of the latent period produced more infections per trial per Aphid in subsequent trials than those that did not.

The experiments of Watson [**25** 283 ; **26** 342 ; **29** 65] and of Watson & Roberts [**28** 301 ; **29** 26] have indicated that the difference in behaviour of sugar-beet yellows (a persistent virus) and *Hyoscyamus* virus 1, which is non-persistent, can be explained on a quantitative rather than qualitative basis, and the authors support this conclusion by an analysis showing that the principal features of the experiments on both viruses can be explained by a quantitative difference in the rates at which they are inactivated while in the Aphid vector. The analysis is based on the postulates that when several Aphids are used per healthy plant they infect independently and that when healthy plants receive treatments that are intended to be identical, the proportion infected is related to the mean dose of virus received per plant. It is calculated that the dosage of *Hyoscyamus* virus 1 that the Aphid can give to a plant is halved for every 12 minutes of previous feeding on another uninfected plant and is represented by the formula $e^{-\alpha t}$, where t is the time in hours spent on the previous uninfected plant and α is a constant. Examination of the results of post-infection fasting experiments showed that for fasting periods up to about 15 minutes, the diminution in infectiveness occurs at about the same rate as in the consecutive feeding experiment, but that the rate subsequently diminishes, probably because digestive enzymes inactivate the virus in the insect and the secretion of these enzymes ceases during starvation. Since the quantity of *Hyoscyamus* virus 1 in an Aphid is reduced to a small fraction of the initial quantity one hour after the removal of the insect from the source of infection, it is unlikely that the proportion of healthy plants that become infected would be greatly increased by feeding times of more than one hour on the healthy plants, and a calculation based on the supposition that the rate at which Aphids inject virus into healthy plants is proportional to the quantity of virus in the

Aphids at the particular moment ($e^{-\alpha t}$) confirms this. The effect of preliminary fasting before feeding for a short time on the source of infection in increasing the proportion of healthy plants subsequently infected with *Hyoscyamus* virus 1 is discussed, and it is shown that this can be calculated quantitatively from the same formula on the assumption that an Aphid feeds much more rapidly when it has been sting and thus acquires a maximum dose before there is time for the virus to be inactivated. It appears therefore that a fair representation of the main experimental facts on the transmission of *Hyoscyamus* virus 1 by Aphids can be obtained on the simple concept of diminution of virus activity at the rate of $e^{-\alpha t}$, and analysis of the results obtained with the virus of sugar-beet yellows, which is reduced to half-activity in the vector in about 100 minutes, shows that the same formula could be used for this virus if a different value was given to the constant α.

The authors conclude that the main features of the experimental results can be explained in terms of different rates of inactivation of the virus in the insect, and show that these considerations explain why non-persistent viruses are more commonly sap-transmissible than persistent viruses. They do not consider it desirable to complicate the formula $e^{-\alpha t}$ to take account of the fact that the rate of diminution of virus activity in the Aphid is not actually constant but appears gradually to become slower. The difference in rate is not difficult to explain. In the experiments with the two tobacco viruses, in which there is no appreciable inactivation, the 48 hours during which the infectivity of the Aphid increases after a short feeding-period on an infected plant is perhaps the time required for the virus to reach its full concentration in the salivary glands. In the case of *Hyoscyamus* virus 1 and the sugar-beet yellows virus, this slow increase will be superimposed on the rapid decrease due to inactivation of the virus in the insect.

CALLAN (E. McC.). **Effect of Defoliation on Reproduction of** *Cordia macrostachya*.—*Bull. ent. Res.* **39** pt. 2 pp. 213–215, 2 refs. London, 1948.

Cordia macrostachya, a plant native to tropical America that was probably introduced into Mauritius about 1890 from British Guiana, spread rapidly over that island and has become so serious a weed that an investigation of its insect enemies in its native environment was made in Trinidad. The most promising insects for introduction into Mauritius proved to be the Cassidid, *Physonota alutacea*, Boh., and the Galerucid, *Schematiza cordiae*, Barber, which were very destructive to the foliage and appeared to be specific to the plant. Although it has been shown in Mauritius that the plant can withstand considerable defoliation, so that the beetles might not inflict sufficient damage to destroy it, they might reduce its reproductive capacity sufficiently for it to become a subordinate instead of a dominant species. Defoliation experiments were therefore carried out in Trinidad in October–December 1945 to obtain information on this point before the introduction of the beetles into Mauritius was attempted. As it was impossible to infest the plants with enough beetles to cause defoliation, the larger leaves (10–15 cm. in length) were removed by hand at weekly intervals. An average of 110 leaves per plant per week was removed for eight weeks, and it was found that the average numbers of new inflorescences, flower-buds and fruits produced per plant were 15·9, 219 and 16·2 on defoliated plants and 35·8, 564 and 171 on untreated ones, the average lengths of the inflorescences being 5 and 8·9 cm., respectively. The effect of defoliation is clearly indicated, particularly as regards fruit production, untreated plants producing more than ten times as many fruits as defoliated ones, probably as a result of depletion of food reserves in the latter. As the plant appears to reproduce entirely by seed, it is concluded that defoliation has a significant effect in reducing its reproductive capacity.

Simmonds (F. J.). **The effective Control by Parasites of *Schematiza cordiae*, Barber, in Trinidad.**—*Bull. ent. Res.* **39** pt. 2 pp. 217–220, 1 fig. London, 1948.

Investigations were begun in Trinidad in 1946 on the biology of *Schematiza cordiae*, Barber, the larvae and adults of which feed on the leaves of *Cordia macrostachya* [*cf.* preceding abstract], and its destruction by parasites. The Galerucid is widespread and common, and occasionally damages much of the leaf area of *Cordia* plants, but is seldom abundant enough to injure them seriously. Individual leaves are not eaten entirely, but different amounts of skeletonising occur, and this is particularly severe on the small tender shoots of small bushes.

In the laboratory, the adults lived for up to ten weeks and produced up to about 1,000 eggs per pair. The insect is tolerant to the fairly wide range of environments found in Trinidad, but observations in the field indicated that parasitism is very high and that predacious wasps, principally *Polistes canadensis*, L., ants and insectivorous birds destroy some of the larvae. In collections, 83·9 per cent. of the eggs were parasitised by an undescribed Eulophid of the genus *Tetrastichus*, and 69·6 per cent. of the larvae in the first instar, 86·2 per cent. of those in the second and 83·3 per cent. of those in the third and fourth by the larviparous Tachinid, *Chaetonodexodes marshalli*, Aldr. ; 1·4 per cent. of those in the second instar and 7·9 per cent. of those in the third and fourth were hyperparasitised by a species of *Spilochalcis*. The larvae may be parasitised by *C. marshalli* from the time of hatching until possibly the end of the second instar. The Tachinid larva develops within its host, but does not reach the second instar until the latter has ceased to feed. Before this it may itself be attacked by *Spilochalcis*, which deposits an egg within its body ; this egg does not hatch until the primary host has become full-grown. There are other parasites that attack *Schematiza*, but *Tetrastichus* and *Chaetonodexodes* are the commonest and have most effect in reducing its numbers.

In a test to find what effect *Schematiza* would have on *Cordia* plants in the absence of parasites, three plants were covered with cages of half-inch mesh wire netting and three with cages of fine cheese-cloth for eight weeks. After five weeks, a few adults and egg-masses of *Schematiza* were observed in all the cages, and three weeks later the bushes in the wire cages were healthy, whereas those in the cheese-cloth cages were completely defoliated, the leaves skeletonised by *Schematiza* having dropped off. Although the number of larvae, pupae and adults of *Schematiza* in each cheese-cloth cage was conservatively estimated at about 2,000–3,000, other weeds in the cages were practically untouched. It was considered that although the larvae were protected from rain beating down on the bushes in the cheese-cloth cages, this is unlikely to have caused the difference, and that the absence from the cheese-cloth cages of insect parasites and predators, which entered the wire cages freely, was probably responsible for the rapid increase of *Schematiza*. Ants were present in all cages, and birds were excluded from all. When the cages were removed, a very high concentration of larvae and adults of *Schematiza* was found in their immediate vicinity ; the percentage parasitism in egg-masses by *Tetrastichus* was 39·9 near the cages and 77·4 at a distance, and that in larvae by *Chaetonodexodes* was 100 for the first instar, 94·2 (with 3·1 per cent. hyperparasitism by *Spilochalcis*) for the second and 81·8 (with 11·1 per cent. hyperparasitism) for the third and fourth near the cages, and 80·7 and 93·6 for the first and second instar, and 100 (with 12·5 per cent. hyperparasitism) for the third and fourth at a distance, the decline in the parasitism of larvae near the cages being due to the numbers of half-grown larvae freed from them.

These results indicate that *Tetrastichus* cannot react quickly to a sudden local increase in the numbers of *Schematiza* eggs, possibly owing to poor mobility of the adults, whereas *Chaetonodexodes* appears to control local increases in numbers of host larvae very quickly. Large numbers of this Tachinid were seen flying about the bushes. Subsequently, comparatively few young larvae were found and parasitism of egg-masses was nearly as high near the cages as at a distance, and a very short time after the population of *Schematiza* had been artificially increased, the appearance of the *Cordia* plants showed that it was well controlled by natural enemies and that no serious damage would be caused to the plants.

JEPSON (W. F.). **An annotated List of Insects associated with Ground-nuts in East Africa.**—*Bull. ent. Res.* **39** pt. 2 pp. 231–236, 1 ref. London, 1948.

It is considered that as the scheme for the mechanised production of ground-nuts in East Africa is carried out, a restricted number of major insect pests may threaten to limit production over large areas unless energetic measures are adopted for the protection of the plants from the outset by preventing the development of large populations. In particular, the seasonal arrangement of the other crops in the rotation will require careful adjustment to avoid the mass increase of pests common to a number of crops.

In view of this danger, the author has compiled a list of the injurious insects that may be expected to appear on the crop sooner or later in any part of the area, compiled from the records of the Departments of Agriculture of Tanganyika, Kenya and Uganda, reviews of work carried out in the adjacent territory of the Belgian Congo and other sources. The list comprises nearly 50 insects that attack the standing crop, including Orthoptera, Isoptera, Thysanoptera, Hemiptera, Lepidoptera and Coleoptera, and three that attack the stored shelled or unshelled seeds. The most important of those attacking the growing plants are *Chrotogonus rotundatus*, Kby., which is a solitary grasshopper injurious to the young foliage of many ground crops in Tanganyika and which, together with related species and genera, particularly two species of *Eupropacris*, is considered likely to appear in large numbers in the area adjacent to the new Kongwa groundnut region; *Aphis laburni*, Kalt., which occurs in Uganda, Tanganyika, Nyasaland and the Belgian Congo, and is the sole or principle vector of the virus [*Marmor arachidis* of Holmes] that causes rosette disease [*cf. R.A.E.*, A **24** 285; **32** 257]; *Pseudococcus brevipes*, Ckll., which is particularly prevalent in badly drained plantings and may cause blackening of the seeds; *Laphygma exempta*, Wlk., and *L. exigua*, Hb., which are likely to attack all grain and leguminous crops unless they are controlled soon after their appearance on wild grasses, especially *Cynodon dactylon*; and *Alcidodes dentipes*, Ol., which girdles the stems and is widespread in native plantings, and *Coryna apicicornis*, Guér., which attacks the flowers and young shoots, both in Tanganyika.

The pests of the stored product are *Ephestia cautella*, Wlk., which attacks both shelled and unshelled groundnuts and is always present, sometimes in very large numbers, in native produce stored in commercial godowns in Uganda and Tanganyika, *Tenebroides mauritanicus*, L., which is very destructive to shelled groundnuts in bag stores, possibly following primary infestation by *Ephestia*, on the larvae of which it is predacious, and *Tribolium castaneum*, Hbst., which is only a secondary pest.

KAPUR (A. P.). **On the Old World Species of the Genus *Stethorus* Weise (Coleoptera, Coccinellidae).**—*Bull. ent. Res.* **39** pt. 2 pp. 297–320, 75 figs., 63 refs. London, 1948.

The genus *Stethorus* is of interest on account of its cosmopolitan distribution and the habit of its species of feeding mainly on Tetranychid mites, including

some that are important pests. The author lists seven species from the New World and 21 from the Old World, including Australia and New Zealand, and describes 20 of the latter, 12 of which are new. The old- and new-world species of which the feeding habits are known are shown in a table, together with information as to their prey, the plants on which they were taken and the country as recorded in the literature or stated on the labels attached to the material studied. They all feed on mites, although there are single records of one species attacking an Aphid and a thrips. The records not obtained from the literature are from India ; they comprise *S. tetranychi*, sp. n., feeding on *Tetranychus* sp. on jute in Bengal, and *S. pauperculus*, Weise, and *S. gilvifrons*, Muls., feeding on unidentified mites on various crops. *S. pauperculus* has been erroneously recorded as *Scymnus gracilis*, Motsch., attacking *Paratetranychus indicus*, Hirst, on sorghum in south India [*R.A.E.*, A **21** 322], and *Stethorus bifidus*, sp. n., which is predacious on *P. pilosus*, C. & F., on apple in New Zealand, has been misidentified as *Scymnus* sp. near *minutulus*, Broun [**22** 657].

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Moursi (A. A.). **The Effect of Temperature on the Sex Ratio of parasitic Hymenoptera** [studies on *Mormoniella vitripennis*, Wlk.].—*Bull. Soc. Fouad Ier Ent.* **30** pp. 21–37, 1 fig., 3 graphs, 20 refs. Cairo, 1946. **The Effect of Temperature on Development and Reproduction of** *Mormoniella vitripennis* **(Walker) (Hymenoptera : Chalcidoidea—Pteromalidae).**—*T.c.* pp. 39–61, 3 figs., 5 graphs, 45 refs. [See *R.A.E.*, B **36** 202.]

Radford (C. D.). **Larval and nymphal Mites (Acarina ; Trombiculidae) from Ceylon and the Maldive Islands** [including larvae of *Womersleyia minuta*, gen. et sp. n. (Leeuwenhoekiinae) parasitic on Acridids, Tetrigids and Tettigoniids in the Maldive Islands].—*Parasitology* **37** no. 1–2 pp. 46–54, 29 figs., 8 refs. London, 1946.

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Subjects	*Openers*
Recent Developments in Insecticides	R. A. E. Galley
Mode of Action of new Insecticides	V. B. Wigglesworth
Uses and Limitations of the new Insecticides in the Field	W. A. Ross
Recent Developments in Pest and Disease Control Machinery	H. G. H. Kearns G. H. Berkeley
Application of Insecticides from the Air ...	D. L. Gunn
Biological Control	A. B. Baird W. Cottier R. H. Le Pelley D. Miller
Estimation of Insect Populations in the Field	A. H. Strickland
Developments in the Control of Stored Products Insects	F. N. Ratcliffe
Tsetse Research and Control	T. A. M. Nash K. R. S. Morris
The Need for Plant Quarantine on a Continental Basis, with special Reference to Africa ...	G. F. Clay
History of the Bureau of Biological Control ...	Sir H. Howard
Locusts and Grasshoppers	B. P. Uvarov A. J. Nicholson
Discussion of Summary of Information on Termites	

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